Easy to build projects for everyone

Everyday ELECTRONICS

DEC. 80
0p

2 E$1.00

...thirteen l.e.d.s,
four carbon resistors,
three polarised caps.,
two digital i.c.s,
and a pp-3
in a pear tree.

Xmas Novelties

Table Decoration
Tree Lights Flasher
and
Two Simple Games

plus

Reverb Unit
Door Chimes

Australia $1·00 New Zealand $1·10 Malaysia $4·50

AND THERE'S MORE WHERE THIS CAME FROM

It's a long time since one of our adverts was presented in 'list' form - but simply because we do not try to squeeze this lot in every time doesn't mean that it's not available. Our new style price list (now some 40 pages long) includes all this and more, including quantity prices and a brief description. The kits, modules and specialized RF components - such as TOKO coils, filters etc. are covered in the general price list - so send now for a free copy (with an SAE please). Part 4 of the catalogue is due out now (incorporating a revised version of pt.1).

LINEAR ICs - NUMERIC LISTINGS

TBA120S	1.00
L200	1.95
U237B	1.28
U247B	1.28
U257B	1.28
U267B	1.28
LM301H	0.67
LM301N	0.30
LM308H	0.96
LM308N	0.65
LM339N	0.66
LM348N	1.86
LF351N	0.38
LF353N	0.76
LM374N	3.75
LM380N-14	1.00
LM380N-8	1.00
LM381N	1.81
ZN419CE	1.95
NE544N	1.80
NE555N	0.30
NE556N	0.50
NE560N	3.50
NE562N	4.05
NE564N	4.29
NE565N	1.00
NE566N	1.60
NE570N	3.85
SL624	3.28
TBA651	1.81
uA709HC	0.64
uA709PC	0.36
uA710HC	0.65
uA710PC	0.59
uA741CH	0.66
uA741CN	0.27
uA747CN	0.70
uA748CN	0.36
uA753	2.44
uA758	2.35
TBA810AS	1.09
TBA820M	0.75
TCA940E	1.80
TDA1028	2.11
TDA1029	2.11
TDA1054	1.45
TDA1062	1.95
TDA1072	2.69
TDA1074A	5.04
TDA1083	1.95
TDA1090	3.05
HA1137	1.20
HA1196	2.00
HA1197	1.00
TDA1220	1.40
LM1303	0.99
LM1307	1.55
MC1310P	1.90
MC1330	1.20
MC1350	1.20
HA1370	1.90
HA1388	2.75
TDA1490	1.86
MC1496P	1.25
SL1610P	1.60
SL1611P	1.60
SL1612P	1.60
SL1613P	1.89
SL1620P	2.17
SL1621P	2.17
SL1623P	2.24
SL624C	3.28
SL1625P	2.17
SL1626P	2.44
SL1630P	1.62
SL1640P	1.89
SL1641P	1.89
TDA2002	1.25
TDA2020	3.00
ULN2242A	3.05
ULN2283B	1.00
CA3080E	0.70
CA3089E	1.84
CA3090AQ	3.35
CA3123E	1.40
CA3130E	0.80
CA3130T	0.90
CA3140E	0.46
CA3189E	2.20
MC3357P	2.35
LM3900N	0.60
LM3909N	0.68
LM3914N	2.80
LM3915N	2.80
KB4400	0.80
KB4406	0.60
KB4412	1.95
KB4413	1.95
KB4417	1.80
TDA4420	2.25
KB4420B	1.09
KB4423	2.30
KB4424	1.65
KB4431	1.95
KB4432	1.95
KB4433	1.52
KB4436	2.53
KB4437	1.75
KB4438	2.22
KB4441	1.35
KB4445	1.29
KB4446	2.75
KB4448	1.65
NE5044N	2.26
NE5532N	1.85
SD6000	3.75
SL6270	2.03
SL6310	2.03
SL6600	3.75
SL6640	2.75
SL6690	3.20
SL6700	2.35
ICL8038CC	4.50
MSL9362	1.75
MSL9363	1.75
HA11211	1.95
HA11223	2.15
HA11225	1.45
HA12002	1.45
HA12017	0.80
HA12402	1.95
HA12411	1.20
HA12412	1.55
LF13741	0.33
SN76660N	0.80

FREQUENCY DISPLAY & SYNTHESISER ICs

SAA1056	3.75
SAA1058	3.35
SAA1059	3.35
11C90DC	14.00
LN1232	19.00
LN1242	19.00
MSL2318	3.84
MSM5523	11.30
MSM5524	11.30
MSM5525	7.85
MSM5526	7.85
MSM5527	9.75
MSM55271	9.75
ICM7106CP	9.55
ICM7107CP	9.55
ICM7216B	19.25
ICM7217A	9.50
SP8629	3.85
SP8647	6.00
95H90PC	6.00
HD10551	2.45
HD44015	4.45
HD12009	6.00
HD44752	8.00

CMOS 4000 SERIES

4001	0.17
4000	0.17
4002	0.23
4008	0.80
4009	0.58
4010B	0.58
4011AE	0.20
4011B	0.20
4012	0.55
4013	0.55
4015	0.95
4016	0.52
4017	0.80
4019	0.60
4020B	0.93
4021	0.82
4022	0.90
4023	0.17
4024	0.76
4025	0.17
4026	1.80
4028	0.72
4029	1.00
4030	0.58
4035	1.20
4040	0.83
4042	0.85
4043	0.85
4044	0.80
4046	1.30
4047	0.99
4049	0.52
4050	0.55
4051	0.65
4052	0.65
4053	0.65
4063	1.09
4066	0.56
4068	0.25
4069	0.20
4070	0.20
4071	0.20
4072	0.20
4073	0.20
4075	0.20
4076	0.90
4077	0.20
4078	0.20
4082	0.20
4093	0.78
4175	0.95
4503	0.69
4506	0.51
4510	0.99
4511	1.49
4512	0.98
4514	2.55
4518	1.03
4520	1.09
4521	2.36
4522	1.49
4529	1.41
4539	1.10
4549	3.50
4554	1.53
4560	2.18
4566	1.59
4568	2.18
4569	3.03
4572	0.30
4585	1.10

TTL N and LSN

7400N	0.13
74LS00	0.20
7401N	0.13
74LS01	0.20
7402N	0.14
74LS02	0.20
7403N	0.14
74LS03	0.20
7404N	0.14
74LS04	0.24
7405N	0.18
74LS05	0.26
7406N	0.28
7407N	0.38
7408N	0.17
74LS08	0.24
7409N	0.17
74LS09	0.24
7410N	0.15
74LS10	0.24
7411N	0.20
74LS11	0.24
7412N	0.17
7413N	0.30
7414N	0.51
74LS15	0.24
7416N	0.30
7417N	0.30
7420N	0.16
74LS20	0.24
7421N	0.29
74LS21	0.24
7423N	0.27
7425N	0.27
7427N	0.27
74LS27	0.44
7428N	0.35
74LS28	0.32
7430N	0.17
74LS30	0.24
7432N	0.25
74LS32	0.24
7437N	0.40
7438N	0.33
74LS38	0.24
7440N	0.17
74LS40	0.24
7441N	0.74
7442N	0.70
74LS42	0.99
7443N	1.15
7444N	1.12
7445N	0.94
7446N	0.94
74LS47	0.89
7448N	0.56
74LS48	0.99
74LS49	0.99
7451N	0.17
74LS51	0.24
7453N	0.17
7454N	0.17
74LS54	0.24
74LS55	0.24
7460N	0.17
74LS63	1.24
7470N	0.28
7472N	0.28
7473N	0.32
74LS73	0.38
7474N	0.27
74LS74	0.28
7475N	0.38
7476N	0.37
74LS76	0.38
74LS78	0.38
7480N	0.48
7481N	0.86
7482N	0.69
7485N	1.04
74LS85	0.99
74LS86	0.40
7489N	2.05
7490N	0.33
74LS90	0.90
7491N	0.76
74LS91	1.10
7492N	0.38
74LS92	0.78
7493N	0.32
74LS93	0.99
7494N	0.78
7495N	0.65
74LS95	1.14
7496N	0.58
74LS96	1.20
7497N	1.85
74LS107	0.38
74109N	0.63
74LS109	0.70
74110N	0.54
74111N	0.68
74LS112	0.38
74LS113	0.38
74LS114	0.38
74118N	0.83
74120N	1.15
74121N	0.42
74122N	0.46
74123N	0.73
74LS124	1.75
74125N	0.38
74LS125	0.44
74126N	0.57
74LS126	0.44
74128N	0.74
74132N	0.73
74LS132	0.78
74LS136	0.40
74LS138	0.60
74141N	0.56
74142N	2.65
74143N	3.12
74144N	3.12
74LS145	0.97
74147N	1.75
74148N	1.09
74LS148	1.19
74150N	0.99
74151N	0.55
74LS151	0.84
74153N	0.64
74LS153	0.54
74154N	0.96
74155N	0.54
74LS155	1.10
74156N	0.80
74157N	0.67
74LS157	0.55
74LS158	0.60
74159N	2.10
74160N	0.82
74LS160	1.30
74161N	0.92
74LS161	0.78
74LS162	1.30
74163N	0.92
74LS163	0.78
74164N	1.04
74LS164	1.30
74165N	1.05
74LS165	1.04
74167N	2.50
74LS169	2.00
74170N	2.30
74LS170	2.00
74LS174	1.20
74175N	0.87
74LS175	1.10
74176N	0.75
74177N	0.78
74181N	1.65
74LS181	3.50
74LS183	2.10
74184N	1.35
74185N	1.34
74LS190	0.92
74192N	1.05
74LS192	1.80
74193N	1.05
74LS193	1.80
74194N	1.05
74196N	0.99
74LS196	1.10
74LS197	1.10
74198N	1.50
74199N	1.60
74LS247	0.93
74LS257	1.08
74LS260	1.53
74LS279	0.52
74LS283	1.20
74LS293	0.95
74LS365	0.49
74LS366	0.49
74LS367	0.43
74LS368	0.49
74LS374	1.80
74LS377	1.95
74LS379	1.30
74LS393	1.40

VOLTAGE REGULATORS

78series	0.95
79series	1.00
78Mseries	0.65
78Lseries	0.35
79L05	0.85
78MGT2C	1.75
79MGT2C	1.75
723CN	0.65
L200	1.95
TDA1412	0.75
NE5553N	1.25
LM317MP	1.48
LM337MP	1.48

MICROMARKET

8080A/2	7.50
8212	2.30
8214	3.50
8216	1.95
8224	3.50
8251	6.25
8255	5.40
6800P	7.50
6810	5.95
6820	7.45
6850	4.90
6852	4.85
MC2708	7.50
2114	6.50
4027	5.78
2102	1.70
2112	3.40
2513	7.54
HM4716	4.50
81LS97	1.25

CRYSTAL FILTER PRODUCTS

10.7MHZ 2 POLE TYPES:	
10M15A 15KHZ BW	2.49
10.7MHZ 8 POLE TYPES:	
10M4B1 15kHz BW	14.50
H4402 7.5KHZ BW	15.50
10M22D 2.4KHZ SSB	17.20
HF FIRST FILTER:	
B34F8A 34.5MHz HF	32.00

RADIO CONTROL CRYSTALS

(No splits available)

AM TX:-	
3rd OT 30pF HC25U	1.65
AM/FM RX:-	
3rd OT 30pF HC25U	1.65
FM TX :-	
Fund 20pF HC25U	1.85
Pairs FM	3.25
Pairs AM	3.10

CRYSTALS

32.768 kHz	2.70
100kHZ	3.85
455kHZ	5.00
1.0MHz	3.00
3.2768MHz	2.70
4.000MHz	2.00
4.19439MHz	2.30
6.5536MHz	2.10
10.0MHz	2.50
10.6985MHz	2.50
10.7015MHz	2.50
10.245MHz	2.50
10.7MHz	3.00
11.52MHz	2.50
100MHz	3.00

TOKO COILS AND FILTERS SEE THE EXTENSIVE SECTION IN OUR NEW PRICE LISTS AND CATALOGUE

LF/HF FIXED INDUCTORS –FULL E12 RANGE

7BA series 1uH-1mH	0.16
8RB series 100uH-33mH	0.19
10RB series 33mH-120mH	0.33
10RBH series 120mH-1.5H	0.55
PIEZO SOUNDER PB2720	0.44

LEDs

5MM RED	0.12
3MM RED CLEAR	0.15
3MM RED	0.15
2.5 X 5MM RED	0.17
5MM GREEN	0.15
3MM GN CLEAR	0.16
3MM GREEN	0.16
2.5 X 5MM GN	0.20
5MM YELLOW	0.15
3MM YELLOW CL	0.16
3MM YELLOW	0.18
2.5 X 5MM YE	0.20
5MM ORANGERED	0.20
5MM ORA CL	0.29
3MM ORANGERED	0.19
2.5 X 5MM ORA	0.24
5MM INFRA RED	0.56
BPW41 IR DET	1.51
IR OPT CPLR	1.44
5MM CLIP	0.04

LCDs

3.5 digit	9.45
4 digit	8.95
5 digit	8.95

SCHOTTKY DIODE BAL MIXERS (SBL1=MD108)

SBL1 1-500MHz	4.25
SBL1-8 .1-200MHz	4.55
SBL1-X 10-1000MHZ	5.75
SRA1 .5-500MHz	8.45
SRA1-1 .1-500MHz	9.25
SRA1H .5-500MHz	13.35
SRA3 .025-200MHz	10.25

VARICAP TUNING DIODES

BA102	0.30
BA121	0.30
ITT210	0.30
BB204B	0.36
BB105B	0.36
BB109	0.27
MVM125	1.05
BB212	1.95
KV1210	2.45
KV1211	1.75
KV1226	1.95
KV1225	2.75
KV1215	2.55
KV1225	2.75

SWITCHING AND PIN DIODES SHOTTKY DIODES

1N6263	0.62
BA182	0.19
BA244	0.17
BA379	0.35
TDA1061	0.95

SIGNAL DIODES & RECTIFIERS

1N4148	0.06
1N4001	0.06
1N4002	0.07
1N5402	0.15
OA91	0.07
AA112	0.25
BRIDGES:	
1A/50V	0.35
6A/200V	0.75

TRANSISTORS AUDIO DEVICES

BC237	0.08
BC238	0.08
BC239	0.08
BC307	0.08
BC308	0.08
BC309	0.08
BC413	0.10
BC414	0.11
BC415	0.07
BC416	0.08
BC546	0.12
BC556	0.12
BC550	0.12
BC560	0.12
BC639	0.22
BC640	0.23
2SC1775	0.18
2SA872A	0.14
2SD666A	0.30
2SB646A	0.30
2SD668A	0.40
2SB648A	0.40
2SD760	0.45
2SB720	0.45
2SC2546	0.19
2SA1084	0.20
2SC2547	0.19
2SA1085	0.20

AUDIO POWER DEVICES

2SB753	2.34
2SB723	2.34
2SK133	3.00
2SJ 48	3.00
2SK134	3.10
2SK135	3.75
2SJ 50	3.75
BD535	0.52
BD536	0.52
BD377	0.33
BD378	0.33
BD165	0.30
BD166	0.31

SMALL SIGNAL RF DEVICES

BF194	0.18
BF195	0.18
BF224	0.22
BF241	0.18
BF274	0.18
BF440	0.21
BF441	0.21
BF362	0.49
BF395	0.18
BF479	0.66
BF679S	0.55
BFR91	1.33
BFW92	0.60
BFT95	0.99
BFY90	0.90
40238	0.85

RF POWER DEVICES

VN66AF	0.95
2N3866	0.85

SMALL SIGNAL RF FET/MOSFET

BF256	0.38
2SK55	0.28
2SK168	0.35
J310	0.69
J176	0.65
40823	0.65
40673	3SK51
3SK45	0.49
3SK51	0.54
3SK60	0.58
MEM680	0.75
BF961	0.70
BF960	1.24
3SK48	1.64

LCD Module

CM161.
Miniature clock, 12/24 hr., alarm, day, date, backlight.
All for......**9.95**

CAPACITORS

All 5mm or less spacing

CERAMIC 50v
2P2,3P3,4P7,6P8
8P2,10P,15P,18P..0.04
22P,27P,33P,47P
56P,68P,82P,100P.0.05
150P,220P,270P
330P,390P,470P...0.055
1N0,2N2,3N3,4N7..0.06
10N (0.01uF)....0.05
22N,47N..........0.06
100N,220N........0.09
MONOLITHIC CERAMIC
10N,100N.........0.16

FEEDTHRU
1N0 SOLDER IN....0.09

POLYESTER (SIEMENS)
10mm LEAD SPACING
10N,22N,33N......0.17
47N,68N,100N.....0.19
220N,470N........0.22
1uF..............0.29

POLYESTER (GENERAL)
10mm LEAD SPACING
10N,15N,22N,33N..0.06
47N,68N,100N.....0.08
220N.............0.11
20mm LEAD SPACING
220N,330N,470N...0.18

MYLAR
5mm LEAD SPACING
1N0,10N,22N,33N..0.08
100N.............0.09
20mm LEAD SPACING
220N,470N....... 0.17

POLYSTYRENE
10P,15P,18P,22P,
27P,47P,56P,68P..0.08
100P,180P,220P,
270P,330P,390P...0.09
470P,680P,820P...0.10
1N0,1N2,1N5,1N8..0.11
2N2,2N7,3N3,3N9..0.12
4N7,5N6,6N8,10N..0.13

TANTALUM BEAD CAPS
16v: 0.22,0.33,
0.68,1.0.........0.18
16v: 2.2,4.7,10..0.19
6v3: 22,47.......0.30
10v: 22,100......0.35

ALUMIN ELECTROLYTICS RADIAL (VERT. MOUNT)

(uF/voltage)
1/63,2.2/50,4.7/35
10/16,15/16,22/10
33/6.3...........0.08
22/16,33/10,
47/10............0.09
10/63,22/50,33/50,
47/16,100/16.....0.10
47/63,100/25,220/16
470/6.3..........0.12
100/63,470/16,
1000/10..........0.18
1000/16,470/63...0.23
1000/63,2200/16..0.30
3300/25..........0.69
1000/100.........0.88
10000/70.........3.00

AXIAL (HORIZ. MOUNT)
1/25,4.7/16,6.4/25
10/16............0.08
4.7/63,22/10,22/16
33/16............0.09
47/25,100/16.....0.10
100/25...........0.11
1000/16..........0.25
2200/16,1000/25..0.36
1000/35,4700/16..0.45
1000/50..........0.58

RESISTORS

0.25W, 5% E12 CARBON
1ohm-10M.........0.02
0.25W 1% E12 METAL FILM
1.1ohm-1M........0.05

HORIZ CARBON PRESETS
10mm TYPE
100ohms-2M5......0.12
HORIZ CERMET PRESETS
1k, 10k..........0.27

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SHAVER INVERTER. Apr. 79. **£18·98.**

AUTOPHASE. June 80. **£21·41.** Rectangular Case.

COURTESY LIGHT DELAY. June 80. **£6 09.**

A.F. SIGNAL GENERATOR. June 80. **£22·54.**

AUTOWAA. June 80. **£21·33.** Rectangular Case.

G.P. AMPLIFIER. June 80. **£6·60.**

SIGNAL TRACER. June 80. **£5·50.**

ZENER DIODE TESTER. June 80. **£5·67.**

CRICKET GAME. Aug. 80. **£17·42.**

BRAKESAFE MONITOR. Aug. 80. **£7·81.**

WEATHER CENTRE. Aug. 80. **£73·78** exc. hardware + wire for sensors.

AUDIO MILLIVOLTMETER. Aug. 80. **£17·86.**

4 STATION RADIO. May 80. **£13·94** less case.

AUTOFADE. May 80. **£9·96.**

LIGHTS WARNING SYSTEM. May 80. **£3·99.**

BATTERY VOLTAGE MONITOR May 80. **£4·21.**

AUDIO TONE GENERATOR. May 80. **£3·53.**

GAS SENTINEL. April 80. **£26·32.**

SPRING LINE REVERB. UNIT. Jan. 80. **£21·05.**

MICROCHIME DOORBELL. Feb. 79. **£13·48.**

AUTO LEVEL CONTROL. April 80. **£7·69.**

CABLE & PIPE LOCATOR. Mar. 80. **£3·40** less coil former.

KITCHEN TIMER. Mar. 80. **£12·46.**

STEREO HEADPHONE AMPLIFIER. Mar. 80. **£14·94.**

5 RANGE CURRENT LIMITER. Mar. 80. **£4·24.**

MICRO MUSIC BOX. Feb. 80 **£13·82.** Grey Case £3·63 extra.

SIMPLE SHORT WAVE RECEIVER. Feb. 80. **£20·47,** headphones £3·28.

SLIDE/TAPE SYNCHRONISER. Feb. 80. **£10·46.**

MORSE PRATICE OSCILLATOR. Feb 80. **£3·93.**

UNIBOARD BURGLAR ALARM. Dec. 79. **£5·13.**

BABY ALARM. Nov. 79 **£8·20**

OPTO ALARM. Nov. 79 **£5·77** inc. optional ports.

MW /LW RADIO TUNER. Nov. 79 **£15·50** less dial.

ONE ARMED BANDIT. Oct 79. **£18·39.** case extra **£3·98.**

HIGH IMPEDANCE VOLTMETER. Oct. 79. **£15·87.**

CHASER LIGHTS. Sept. 79. **£18·95.**

VARICAP M.W. RADIO. Sept. 79. **£8·98.**

SIMPLE TRANSISTOR TESTER. Sept. 79. **£6·26.**

ELECTRONIC TUNING FORK Aug. 79 **£9·15.** Suitable microphone & plug **£1·59** extra.

WARBLING TIMER. Aug. 79. **£6·25**

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DARKROOM TIMER. July 79. **£2·47.**

TREMOLO UNIT. June 79. **£11·26.**

ELECTRONIC CANARY. June 79. **£4·99.**

LOW COST METAL LOCATOR. June 79. **£5·44.** Handle & coil former parts extra **£5·55.**

METER AMPLIFIER. June 79. **£4·32.**

QUAD SIMULATOR. June 79. **£6·25.**

INTRUDER ALARM. May 1979. **£16·71.** Less Ext. Buzzer & Lamp and Loop Components.

THERMOSTAT. 'PHOTO' SOLUTIONS. May 79. **£16·02.** Less socket, tube and grease.

TRANSISTOR TESTER. April 79. **£4·05.**

TOUCH BLEEPER. April 79. **£3·52.**

ONE TRANSISTOR RADIO. Mar. 79. with Amplifier & Headset. Less case. **£6·93.**

AUDIO MODULATOR. Feb. 79. **£1·56** less case and pins.

THYRISTOR TESTER. Feb. 79. **£3·22.**

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VEHICLE IMMOBILISER. Inc. PCB. Dec. 78. **£5·74.**

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AUDIO EFFECTS OSCILLATOR. Nov 78. **£3·99** inc. board.

FUSE CHECKER. Oct. 78. **£1·97.**

C.MOS RADIO. Oct. 78. **£9·39.**

TREASURE HUNTER. Oct. 78. **£17·86** less handle & coil former.

GUITAR TONE BOOSTER. Sept. 78. **£4·99** inc. p.c.b.

SOUND TO LIGHT. Sept. 78. **£6·98.**

FILTER. £1·66

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R.F. SIGNAL GENERATOR. Sept. 78. **£18·17** less case.

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ADVENTURES WITH ELECTRONICS

by Tom Duncan

An easy to follow book suitable for all ages, ideal for beginners. No Soldering. Uses an 'S Dec' breadboard. Gives clear instructions with lots of pictures. 16 projects—including three radios, siren, metronome, organ, intercom, timer, etc. Helps you learn about electronic components and how circuits work. Component pack includes an S-Dec and the components for the projects.

Adventures With Electronics. **£1·75.**

Component Pack **£16·72** less battery.

ADVENTURES WITH MICROELECTRONICS

Same style as above book; 11 projects based on integrated circuits—includes: dice, two-tone doorbell, electronic organ, MW/LW radio, reaction timer, etc. Component pack includes a Bimboard, 1 plug-in breadboard and the components for the projects.

Adventures with Microelectronics **£2·35.**

Component pack **£29·95** less battery.

MICROPROCESSORS FOR BEGINNERS

We have 2 practical microprocessor courses. Both are ideal for learning about this exciting technology. Educational and interesting with practical work. Details in our catalogue or s.a.e. for sheet.

NOV. 80 E.E. KITS

SOUND TO LIGHT Nov. 80. 3 channel. **£21·26** inc. etched & drilled pcb. Less light display.

PRECISION TIMER Nov. 80. **£24·48.**

GUITAR PRACTICE AMPLIFIER Nov. 80. **£10·98** less case. Standard case **£3·58.** High quality case **£8·33.**

SOIL MOISTURE MONITOR Nov. 80. **£4·94** inc. probes.

TRANSISTOR TESTER Nov. 80. **£9·89** inc. test leads.

DOING IT DIGITALLY

A popular educational series for digital TTL circuits (7400 series). Appeared in E.E. in 12 parts—Oct. 78-Sept. 79. A "TTL Test Bed" is constructed and then used to perform the experiments in the series. Experiments include circuits for digital games, a light detector, a sound operated alarm, a moisture sensor, timers + a stopclock, binary/digital decoders, a dice, etc.

TTL TEST BED KIT £29·98.

ADD ON COMPONENTS FOR EXPERIMENTS **£22·73.**

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Simple T.R.F. Design. Covering most Amateur Bands and Short Wave Broadcast Bands. Five controls:—Bandset, Bandspread, Reaction, Wavechange and Attenuator. Coil selection is by Wavechange Switch. Use with Headphones or a Crystal earpiece. Kit contains all the components required, including the P.C. Board & Case. Instructions are included with this kit.

KIT: **£18·97.** Headphones extra **£3·28.**

TEACH - IN - 80

E.E. 12 part series. Oct '79–Sept '80. Covers the basics of electronics —lots of practical work. Circuits are built on a plug-in Eurobreadboard, which is built into a wooden console which houses the power supplies, speaker, meter, pots and LED indicators. The series uses a range of electronic components in the experimental work including a photocell, I.C.s, transistors etc.

Wooden Console (Tutor Deck) kit **£5·98** extra. Includes all the wood, glue, feet and strap handle.
Electronic components, including Eurobeadboard, for the console and the experiments **£25·40** (called list A + B + C by E.E.). Reprints available—Parts 1-12, **45p** each.
List 'C' only **£2·45.**

TOWERS INTERNATIONAL TRANSISTOR SELECTOR £10·50

ANTEX X25 SOLDERING IRON. 25W. **£4·98.**

SOLDERING IRON STAND. £2·03.

SPARE BITS. Small, standard, large. **65p** each.

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LOW COST CUTTERS. £1·69.

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P.C.B. ETCHING KIT. £4·98.

MONO HEADPHONES. 2K Padded. Superior, sensitive. **£2·98.**

STEREO HEADPHONES. 8 ohm. Padded. **£4·29.**

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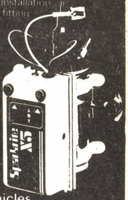

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POLYESTER CAPACITORS: Axial lead type (Values are in µF)
400V: 1nF, 1n5, 2n2, 3n3, 4n7, 6n8, 10m, 15n **9p**; 18n **10p**; 22n, 33n **11p**; 47n, 68n **14p**; 100n **17p**; 150n, 220n, **24p**; 330n, 470n **41p**; 680n **52p**; 1µF **64p**; 2µ **82p**.
160V: 39µF, 100n, 150n, 220n **11p**; 330n, 470n **19p**; 680n, 1µF **22p**; 1µ5, 2µ2 **32p**; 4µ7 **36p**.
1000V: 10nF, 15n, **20p**; 22n **22p**; 47n **26p**; 100n **42p**; 470n **80p**; 1µF **175p**.

POLYESTER RADIAL LEAD CAPACITORS (250V)
10nF, 15n, 22n, 27n, **6p**; 33n, 47n, 68n, 100n **7p**; 150n **10p**; 220n, 330n **13p**; 470n **17p**; 680n **19p**; 1µF **22p**; 1µ5 **30p**; 2µ2 **34p**.

We stock most of the parts for projects in this magazine.

ELECTROLYTIC CAPACITORS: (Values are in uF) 500V: 10 **50p**; 47 **78p**; 250V: 100 **65p**; 63V 0·47, 1·0, 1·5, 2·2, 2·5, 3·3, 4·7, 6·8, **9p**; 10, 15, 22, **11p**; 47, 32, 50 **14p**; 63, 100 **27p**; 50V 100, 220, **25p**; 470 **32p**; 1000 **80p**; 40V: 22, 33, **9p**; 100 **12p**; 2200, 3300 **85p**; 4700 **115p**; 35V: 10, 33 **8p**; 330, 470 **32p**; 25V: 10, 22, 47, 100 **8p**; 160, 220, 250, **15p**; 470 **25p**; 640, 1000 **35p**; 1500 **40p**; 2200 **54p**; 3300 **77p**; 4700 **92p**; 16V: 10, 40, 47 **7p**; 100, 125 **8p**; 220, 330 **16p**; 470 **20p**; 1000, 1500 **30p**; 2200 **36p**; 10V: 100 **7p**;
TAG-END TYPE: 450V: 100µF **180p**; 70V: 4700 **165p**; 64V: 3300 **150p**; 2500 **110p**; 50V: 3300 **135p**; 2200 **99p**; 40V: 4700 **130p**; 4000 **92p**; 3300 **98p**; 2500, 2200 **90p**; 2000 + 2000 **120p**; 30V: 4700 **110p**; 25V: 15000 **195p**; 6400 **120p**; 4700 **100p**; 3000 **85p** 2200 **60p**.

TANTALUM Bead Capacitors
35V: 0·1µF, 0·22, 0·33, 0·47, 0·68, 1·0, 2µ2, 3·3µ, 4·7, 25V: 10, 20V: 6µ8, 16V: 2µ2, 4µ7, 10. **20p.**
16V; 22µ **32p**; 47, 100 **58p**; 220 **70p.**
10V: 15µ, 22, 33, **30p.** 3V: 100 **32p.**

MYLAR FILM CAPACITORS
100V: 0·001, 0·002, 0·005, 0·01µF **6p**
0·015, 0·02, 0·04, 0·05, 0·056µF **7p**
0·1µF **8p** **50V**: 0·47 **12p**

MINIATURE TYPE TRIMMERS
2-5·6pF, 3-10pF, 10-40pF **28p**
5-25pF, 5-45pF, 60pF, 88pF **35p**

COMPRESSION TRIMMERS
3-40pF, 10-80pF **30p**; 25-190pF **33p**
100 500pF **45p** 1250pF **58p.**

POLYSTYRENE CAPACITORS
10pF to 1nF **8p**; 1·5nF to 10nF **10p.**

SILVER MICA (Values in pF) 3-3, 4-7, 6-8, 10, 12, 18, 22, 33, 47, 50, 68, 75, 82, 85, 100, 120, 150, 180 **11p** each
220, 250, 270, 300, 330, 360, 390, 470, 600, 800, 820 **16p** each
1000, 1200, 1800, 2000, 3300 **26p** each

CERAMIC CAPACITORS: 50V 0·5pF to 10nF **4p**; 22n to 100n **7p.**

EURO BREADBOARD £5·20.

POTENTIOMETERS: (ROTARY) Carbon Track. 0·25W Log & 0·5W Linear Value.

500 Ω, 1 K & 2K (Lin. only) Single	**29p**
5K-2 MΩ single gang	**29p**
5K-2 MΩ single with DP switch	**69p**
5K-2 MΩ double gang	**88p**

SLIDER POTENTIOMETER
0·25W log and linear values 60mm

5K Ω-500K Ω single gang	**60p**
10K Ω-500K Ω dual gang	**80p**
Self Stick Graduated Bezels	**36p**

PRESET POTENTIOMETERS
Vertical & Horizontal

0-1W 50 Ω—5MΩ Miniature	**7p**
0-25W 100 Ω—3·3M Ω Horiz	**10p**
0-25W 200 Ω—4·7MΩ Vert	**10p**

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¼W	2Ω2–4M7	E24	**2p**	**1p**
½W	2Ω2–4M7	E12	**2p**	**1p**
1W	2Ω2–10M	E12	**5p**	**4p**
2% Metal Film	10Ω–1M		**6p**	**4p**
1% Metal Film	51Ω–1M		**8p**	**6p**

100+ price applies to Resistors of each value not mixed.

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TIL209 Red	**13**
TIL211 Grn	**18**
TIL212 Yellow	**18**
·2" Red	**14**
2" Yellow Green	**18**
Square LED	**30**
OCP71	**120**
ORP12	**63**
ORP61	**85**
2N5777	**45**
7 Seg Displays	
TIL312 C An 3"	**105**
TIL313 C Cth 3"	**105**
TIL321 C An 5"	**115**
TIL322 C Cth 5"	**115**
DL704 C Cth 3"	**99**
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DL747 C.A. ·6"	**180**
FND357 or 500	**120**
MAN3640	**175**
·3" Green C.A.	**180**
·6" Green C.A.	**225**
LCD 3½ Digit	**875**
TIL32 Inf. Red	**58**
TIL78 detector	**70**
Opto Isolators	
IL74	**48**
TIL111, 112,	**75p.**
TIL116, 117	**100p.**
Bargraph Red. Ten segment	**225p**

SWITCHES
TOGGLE 2A 250V

SPST	**32p**
DPDT	**44p**
SUB-MIN TOGGLE	
SP changeover	**59p**
SPST on/off	**54p**
DPDT 6 tags	**70p**
DPDT c/off	**79p**
DPDT Biased	**115p**

VOLTAGE REGULATORS*

1A	TO3	+ve	—ve	
5V	7805	**145p**	7905	**220p**
12V	7812	**145p**	7912	**220p**
15V	7815	**145p**		—
18V	7818	**145p**		—
1A	TO220 Plastic Casing			
5V	7805	**60p**	7905	**65p**
12V	7812	**60p**	7912	**65p**
15V	7815	**60p**	7915	**65p**
18V	7818	**60p**	7918	**65p**
24V	7824	**60p**	7924	**65p**
100mA	TO92 Plastic Casing			
5V	78L05	**30p**	79L05	**65p**
6V	78L62	**30p**		—
8V	78L82	**30p**		—
12V	78L12	**30p**	79L12	**65p**
15V	78L15	**30p**	79L15	**65p**

CA3085	**95**	LM325N	**240**	TDA1412	**150**
LM300H	**170**	LM326N	**240**	78H05	**595**
LM305H	**140**	LM327N	**270**	78H05+5V/5A	**595**
LM309K	**135**	LM723	**39**		
LM317K	**350**	TAA550	**50**	78HG 5V to 25V	**650**
LM323K	**625**	TBA625B	**95**		

SLIDE 250V:

1A DPDT	**14p**
1A DP c/off.	**15p**
½A DPDT	**13p**
4 pole c/over	**24p**

PUSH BUTTON
Spring Loaded

SPST on/off	**65p**
SPDT c/over	**70p**
DPDT 6 Tag	**95p**

SWITCHES Miniature Non-Locking
Push to Make **15p** Push to Break **25p**
ROCKER: SPST on/off 100A 250V **30p**
ROCKER: Illuminated DPST Lights when on: 3A 240V **85p**
ROTARY: (ADJUSTABLE STOP) 1 pole/2-12 way 2p/2-6W, 3p/2-4W, 4p/2-3W. **43p**
ROTARY: Mains 250V AC, 4 Amp **52p**

DIL SOCKETS (Low Profile – Texas)
8 pin **10p**; 14 pin **12p**; 16 pin **13p**; 18 pin **43p**; 20 pin **22p**; 24 pin **30p**; 28 pin **35p**; 40 pin **40p**.

JACKSONS VARIABLE CAPACITORS
Dilicon 100/300pF **205p**
500pF **250p**
6 1 Ball Drive 4511/DAF **145p**
Dial Drive 4103 6 1/36 1 **775p**
Drum 54mm **59p**
0-1·365pF **325p**
00 2 365pF **395p**
0 2 365pF with slow motion Drive **450p**
00 208/176 **395p**
,, ,, with slow motion drive **410p**
C804-5pF 10 15 25 50 pF **250p**
100, 150pF **335p**
'L' 3 x 310pF **725p**
00·3 x 25pF **550p**

DENCO COILS
'DP' VALVE TYPE Range 1 to 5 Bl., Rd., Yl. Wht. **106p**
6–7 B.Y.R. **95p**
1·5 Green **130p**
'T' 1 to 5 Bl., Yl., Rd., Wht. **130p**
B9A Valve Holder **35p**
RDT2 **120p**
RFC 5 **120p**
RFC 7 (19mH) **133p**
IFT 13; 14; 15; 16; 17 **110p**
IFT 18/1·6 **116p**
IFT 18/465 **132p**
TOC 1 **110p**
MW5FR **112p**
MW/LW 5FR **134p**

VEROBOARD

	0·1 (copper clad)	0·15 (copper clad)	0·15 (plain)
2½ × 3¾	**66p**	**59p**	**34p**
2½ × 5	**75p**	**69p**	—
3¾ × 3¾	**75p**	—	—
3¾ × 5	**86p**	**92p**	**65p**
2½ × 17	**240p**	—	—
3¾ × 17	**296p**	**260p**	**178p**
4¾ × 17	**387p**	—	**280p**
Pkt of 35 pins			**20p**
Spot face cutter			**107p**
Pin insertion tool			**147p**

DIODES

AA129	**25**
BA100	**25**
BY126	**12**
BY127	**12**
CRO33	**158**
OA9	**45**
OA47	**18**
OA70	**12**
OA79	**15**
OA81	**15**
OA85	**15**
OA90	**8**
OA91	**8**
OA95	**8**
OA200	**9**
OA202	**9**
IN914	**4**
IN916	**5**
IN4001/2	**5**
IN4003	**6**
IN4004/5	**6**
IN4006/7	**7**
IN4148	**4**
IS44	**20**
3A/100V	**18**
3A/400V	**20**
3A/600V	**27**
3A/1000V	**30**

We stock a wide selection of Electronic Books and Magazines

ZENERS
Range 2V7 to 39V 400mW **8p each**
Range 3V3 to 33V. 1·3W **15p each**

NOISE
Z5J **180**

BRIDGE RECTIFIERS
(plastic case)

1A/50V	**20**
1A/100V	**22**
1A/200V	**25**
1A/400V	**29**
1A/600V	**34**
2A/50V	**35**
2A/100V	**44**
2A/200V	**46**
2A/400V	**53**
2A/600V	**65**
4A/800V	**120**
6A/100V	**73**
6A/200V	**78**
6A/400V	**85**
BY164	**56**
VM18 DIL	**55**

DIAC
ST2 **25**

SCRs
Thyristors

1A/100V	**42p**
1A/400V	**65p**
1A600V	**70**
5A300V	**35**
5A600V	**43**
8A300V	**48**
8A500V	**58**
8A600V	**85**
12A300V	**58**
12A500V	**92**
15A/700V	**195p**
2N4444	**140p**
2N5062	**28**
2N5064	**35**
BT106	**150**
C106D	**38**
TIC44	**25**
TIC45	**45**

TRIACS

3A100V	**48**
3A200V	**49**
3A400V	**50**
8A100V	**54**
8A400V	**64**
8A800V	**108**
12A100V	**60**
12A400V	**70**
12A800V	**130**
16A100V	**95**
16A500V	**150**
25A800V	**295**
25A1000V	**480**
30A400V	**525**
T28000D	**120**

TTL 74
(TEXAS)

7400	**11**
7401	**12**
7402	**11**
03	**14**
04	**14**
05	**18**
06	**36**
07	**36**
08	**17**
09	**20**
10	**17**
11	**25**
12	**20**
13	**32**
14	**38**
16	**30**
17	**30**
20	**19**
21	**38**
22	**25**
23	**28**
25	**28**
26	**43**
27	**32**
28	**35**
30	**19**
32	**27**
33	**36**
37	**35**
38	**32**
40	**20**
41	**68**
42	**58**
43	**120**
44	**116**
45	**105**
46	**132**
47	**72**
48	**75**
50	**20**
51	**20**
53	**20**
54	**20**
60	**20**
70	**40**
72	**30**
73	**35**
74	**34**
75	**58**
76	**40**
80	**52**
81	**120**
82	**75**
83	**90**
84	**99**
85	**105**
86	**33**
89	**205**
90	**42**
91	**84**
92	**50**
93	**57**
94	**85**
95	**70**
96	**80**
97	**176**
100	**130**
104	**62**
105	**62**
107	**34**
109	**60**
110	**54**
111	**68**
112	**170**
116	**180**
118	**85**
119	**120**
120	**105**
121	**35**
122	**50**
123	**65**
125	**50**
126	**45**
128	**65**
132	**55**
136	**65**
141	**75**
142	**185**
143	**350**
144	**350**
145	**90**
147	**150**
148	**125**
150	**130**
151	**70**
153	**70**
154	**120**
155	**75**
156	**75**
157	**70**
159	**165**
160	**99**
161	**99**
162	**99**
163	**99**
164	**120**
165	**120**
166	**130**
167	**205**
170	**205**
172	**375**
173	**110**
174	**100**
175	**82**
176	**80**
177	**85**
178	**110**
180	**90**
181	**280**
182	**85**
184	**130**
185	**130**
188	**310**
190	**130**
191	**120**
192	**120**
193	**120**
194	**102**
195	**75**
196	**99**
197	**88**

74LS

LS00	**13**
LS01	**13**
LS02	**15**
LS03	**15**
LS04	**20**
LS05	**23**
LS08	**22**
LS09	**23**
LS10	**20**
LS11	**32**
LS12	**32**
LS13	**40**
LS14	**60**
LS15	**40**
LS20	**21**
LS21	**32**
LS22	**35**
LS26	**44**
LS27	**35**
LS28	**35**
LS30	**20**
LS32	**25**
LS33	**35**
LS37	**30**
LS38	**35**
LS40	**28**
LS42	**66**
LS47	**85**
LS51	**25**
LS54	**30**
LS55	**30**
LS73	**45**
LS74	**35**
LS75	**45**
LS76	**45**
LS78	**50**
LS83	**105**
LS85	**80**
LS86	**38**
LS90	**50**
LS91	**125**
LS92	**75**
LS93	**60**
LS95	**115**
LS96	**120**
LS107	**45**
LS109	**75**
LS112	**40**
LS113	**75**
LS114	**40**
LS122	**70**
LS123	**75**
LS124	**180**
LS125	**45**
LS126	**45**
LS132	**60**
LS136	**35**
LS138	**70**
LS139	**70**
LS151	**90**
LS153	**85**
LS155	**75**
LS157	**70**
LS158	**70**
LS160	**90**
LS161	**98**
LS162	**110**
LS163	**95**
LS164	**115**
LS165	**145**
LS166	**175**
LS168	**210**
LS169	**210**
LS170	**288**
LS173	**105**
LS174	**110**
LS175	**110**
LS181	**295**
LS183	**298**
LS191	**120**
LS192	**95**
LS193	**95**
LS194	**125**
LS195	**130**
LS196	**120**
LS197	**85**
LS200	**345**
LS221	**120**
LS240	**225**
LS243	**165**
LS244	**195**
LS245	**350**
LS251	**130**
LS253	**95**
LS257	**95**
LS258	**120**
LS259	**160**
LS261	**450**
LS266	**75**
LS273	**180**
LS279	**88**
LS280	**250**
LS283	**90**
LS290	**130**
LS293	**130**
LS295	**215**
LS298	**215**
LS299	**420**
LS323	**450**
LS365	**65**
LS366	**65**
LS367	**65**
LS368	**90**
LS373	**150**
LS375	**150**
LS374	**180**
LS377	**199**
LS378	**140**
LS379	**215**
LS384	**250**
LS390	**140**
LS393	**140**
LS395	**210**
LS398	**275**
LS399	**230**
LS447	**195**
LS490	**245**
LS668	**105**
LS670	**270**
S673	**750**
S674	**850**

CMOS*

4000	**18**
4001	**18**
4002	**24**
4006	**92**
4007	**22**
4008	**82**
4009	**40**
4010	**48**
4011	**24**
4012	**24**
4013	**45**
4014	**85**
4015	**85**
4016	**42**
4017	**82**
4018	**88**
4019	**48**
4020	**99**
4021	**105**
4022	**95**
4023	**25**
4024	**75**
4025	**25**
4026	**180**
4027	**48**
4028	**82**
4029	**105**
4030	**60**
4031	**225**
4032	**125**
4033	**175**
4034	**210**
4035	**125**
4036	**365**
4037	**115**
4038	**118**
4039	**360**
4040	**105**
4041	**80**
4042	**80**
4043	**95**
4044	**95**
4045	**175**
4046	**130**
4047	**98**
4048	**65**
4049	**45**
4050	**48**
4051	**80**
4052	**80**
4053	**80**
4054	**130**
4055	**135**
4056	**135**
4057	**2850**
4059	**575**
4060	**130**
4061	**1225**
4062	**995**
4063	**120**
4066	**58**
4067	**430**
4068	**26**
4069	**26**
4070	**30**
4071	**25**
4072	**25**
4073	**25**
4075	**25**
4076	**99**
4077	**48**
4078	**30**
4081	**28**
4082	**28**
4085	**90**
4086	**90**
4089	**150**
4093	**89**
4094	**240**
4095	**105**
4096	**105**
4097	**350**
4098	**115**
4099	**190**
4160	**125**
4161	**125**
4162	**125**
4163	**125**
4174	**130**
4175	**120**
4194	**125**
4408	**790**
4409	**790**
4410	**790**
4411	**1020**
4412V	**1520**
4415F	**1520**
4415V	**850**
4419	**850**
4422	**320**
4433	**570**
4435	**1050**
4440	**1050**
4450	**999**
4451	**350**
4452	**350**
4490F	
4490V	**750**
4501	**750**
4502	**28**
4503	**125**
4535	**75**
4506	**75**
4507	**60**
4508	**325**
4510	**99**
4511	**150**
4512	**98**
4513	**225**
4514	**265**
4515	**299**
4516	**120**
4517	**450**
4518	**105**
4519	**70**
4520	**115**

LINEAR IC's

702	**75**
709C 8 pin	**35**
710*	**67**
733	**75**
741 8 pin	**17**
747C 14 pin	**78**
748C 8 pin	**36**
753 8 pin	**185**
810	**159**
AY-1-0212	**595**
AY-1-1313A	**660**
AY-1-1320	**225**
AY-1-5050	**99**
AY-1-5051	**160**
AY-1-6721/6	**210**
AY-3-1270	**840**
AY-3-8500	**390**
AY-3-8910	**850**
AY-5-1224A	**235**
AY-5-1230	**450**
AY-5-1315	**595**
AY-5-1317A	**639**
AY-5-3500	**350**
AY-5-4007D	**450**
AY-5-8100	**735**
CA3011	**110**
CA3014	**157**
CA3018	**68**
CA3020	**186**
CA3023	**191**
CA3028A	**80**
CA3035	**235**
CA3036	**115**
CA3043	**275**
CA3045	**365**
CA3046	**71**
CA3048	**214**
CA3059	**195**
CA3075	**213**
CA3080E	**65**
CA3081	**190**
CA3089E	**215**
CA3090AQ	**375**
CA3123	**150**
CA3130	**90**
CA3140	**48**
ICL7106	**795**
ICL7107	**975**
ICL8038CC	**340**
ICM7205	**1150**
ICM7215	**1050**
ICM7216A	**1950**
ICM7216B	**1950**
ICM7216C	**1950**
ICM7217A	**790**
ICM7555	**89**
LD130	**452**
LF356	**90**
LM10	**395**
LM301A	**26**
LM308T	**95**
LM311H	**70**
LM318	**240**
LM324	**50**
LM339	**70**
LM348	**90**
LM349	**125**
LM379	**375**
LM380	**80**
LM381N	**145**
LM381AN	**248**
LM382	**125**
LM386	**99**
LM387	**120**
LM389	**99**
LM733	**75**
LM1458	**45**
LM3900	**60**
LM3909N	**70**
LM3911	**125**
LM3914	**240**
LM3915	**240**
LM13600	**135**
M252AA	**625**
M253AA	**1150**
MC1303	**88**
MC1304P	**260**
MC1310P	**150**
MC1494	**694**
MC1495	**350**
MC1496L	**92**
MC1596	**225**
MC1710	**79**
MC3302	**150**

TRANSISTORS

AC125	**35**
AC126	**25**
AC127	**25**
AC128	**25**
AC141	**30**
AC142	**30**
AC176	**28**
ACY17	**70**
ACY18	**70**
ACY19	**75**
ACY20	**75**
ACY21	**75**
ACY22	**60**
ACY28	**75**
ACY39	**85**
AD149	**79**
AD161	**42**
AD162	**42**
AF106	**70**
AF118	**95**
AF139	**40**
AF178	**75**
AF239	**78**
BC107	**10**
BC107B	**12**
BC108	**10**
BC108B	**12**
BC108C	**12**
BC109	**10**
BC109B	**12**
BC109C	**12**
BC140	**30**
BC142	**30**
BC143	**30**
BC147	**9**
BC147B	**10**
BC148	**9**
BC148B	**10**
BC148C	**10**
BC149	**9**
BC149C	**10**
BC153	**27**
BC154	**27**
BC157	**10**
BC158	**10**
BC159	**11**
BC160	**45**
BC167	**10**
BC168C	**10**
BC169C	**10**
BC170	**15**
BC172	**11**
BC173	**11**
BC177	**20**
BC178	**20**
BC179	**18**
BC181	**20**
BC182	**10**
BC183	**10**
BC184	**10**
BC182L	**10**
BC183L	**10**
BC184L	**10**
BC187	**26**
BC212	**10**
BC212L	**10**
BC213	**10**
BC213L	**10**
BC214	**10**
BC214L	**10**
BC236	**10**
BC237	**14**
BC307B	**15**
BC308B	**16**
BC327	**15**
BC238	**14**
BC338	**15**
BC441	**34**
BC461	**34**
BC477	**40**
BC516	**40**
BC517	**40**
BC547	**14**
BC548	**14**
BC549C	**14**
BC557	**15**
BC558	**15**
BC559	**15**
BCY70	**16**
BCY71	**18**
BCY72	**20**
BD131	**48**
BD132	**48**
BD133	**60**
BD135	**45**
BD136	**40**
BD137	**40**
BD138	**40**
BD139	**40**
BD140	**40**
BD144	**198**
BD145	**198**
BD205	**110**
BD214	**115**
BD245	**45**
BD378	**70**
BD434	**55**
BD517	**75**
BD695A	**85**
BD696A	**85**
BDY56	**180**
BF115	**35**
BF167	**29**
BF180	**38**
BF194	**12**
BF195	**12**
BF196	**12**
BF197	**12**
BF198	**16**
BF199	**18**
BF200	**30**
BF224	**24**
BF244	**30**
BF245	**28**
BF244B	**30**
BF256	**35**
BF257	**32**
BF258	**32**
BF259	**35**
BF274	**42**
BF336	**40**
BF451	**35**
BF594	**30**
BF595	**39**
BFR39	**23**
BFR40	**23**
BFR41	**23**
BFR79	**23**
BFR80	**24**
BFR81	**25**
BFR98	**105**
BFX29	**28**
BFX84	**26**
BFX85	**28**
BFX86	**28**
BFX87	**28**
BFX88	**28**
BFY50	**23**
BFY51	**23**
BFY52	**23**
BFY56	**32**
BFY64	**35**
BFY81	**120**
BRY39	**40**
BSX20	**20**
BSY95A	**25**
BU105	**170**
BU205	**190**
BU208	**200**
E421	**250**
MD8001	**250**
MJ400	**150**
MJ491	**175**
MJ2955	**90**
MJE340	**54**
MJE370	**100**
MJE371	**100**
MJE2955	**99**
MJE3055	**70**
MPF102	**66**
MPF103	**36**
MPF104	**36**
MPF105	**36**
MPF106	**40**
MPSA05	**25**
MPSA06	**25**
MPSA12	**32**
MPSA55	**30**
MPSA56	**30**
MPSA70	**25**
MPSU06	**55**
OC26	**170**
OC28	**130**
OC35	**125**
OC36	**120**
OC41	**120**
OC42	**120**
OC43	**55**
OC44	**120**
OC45	**40**
OC70	**40**
OC71	**35**
OC72	**40**
OC74	**50**
OC76	**50**
OC81	**50**
OC82	**50**
OC83	**40**
OC84	**40**
OC140	**110**
OC170	**85**
OC171	**85**
OC200	**85**
TIP29	**34**
TIP29A	**36**
TIP29B	**56**
TIP29C	**60**
TIP30	**48**
TIP30C	**56**
TIP31A	**45**
TIP31C	**55**
TIP32A	**48**
TIP32C	**60**
TIP33A	**65**
TIP33C	**78**
TIP34A	**74**
TIP34C	**88**
TIP35A	**160**
TIP35C	**185**
TIP36A	**170**
TIP36C	**199**
TIP41A	**60**
TIP41B	**68**
TIP42A	**60**
TIP42B	**75**
TIP120	**90**
TIP121	**99**
TIP142	**120**
TIP147	**120**
TIP2955	**60**
TIP3055	**60**
TIS43	**32**
TIS44	**45**
TIS45	**45**
TIS88A	**50**
TIS90	**30**
TIS91	**32**
ZTX107	**11**
ZTX109	**12**
ZTX109	**11**
ZTX300	**13**
ZTX301	**16**
ZTX302	**16**
ZTX303	**25**
ZTX304	**17**
ZTX314	**25**
ZTX326	**30**
ZTX341	**30**
ZTX500	**14**
ZTX501	**15**
ZTX502	**15**
ZTX503	**18**
ZTX504	**25**
ZTX531	**25**
ZTX550	**25**
40311	**60**
40313	**125**
40315	**68**
40316	**85**
40361	**50**
40362	**50**
40408	**95**
40411	**280**
40467	**95**
40468	**60**
40594	**90**
40595	**98**
40603	**90**
40673	**95**
2N697	**23**
2N698	**40**
2N699	**35**
2N706A	**19**
2N708	**19**
2N918	**33**
2N1131	**24**
2N1132	**24**
2N1303	**60**
2N1304	**65**
2N1305	**60**
2N1671B	**215**
2N2219A	**28**
2N2220A	**26**
2N2221A	**25**
2N2222A	**25**
2N2369A	**17**
2N2646	**48**
2N2904	**28**
2N2905A	**26**
2N2906	**26**
2N2907A	**26**
2N2926G	**10**
2N3053	**26**
2N3054	**58**
2N3055	**48**
2N3442	**140**
2N3663	**15**
2N3702	**10**
2N3703	**10**
2N3704	**10**
2N3705	**10**
2N3706	**10**
2N3707	**10**
2N3708	**10**
2N3709	**10**
2N3710	**10**
2N3711	**10**
2N3822	**130**
2N3771	**179**
2N3772	**195**
2N3773	**270**
9400CJ	**350**
NE529	**225**
2N3819	**22**
2N3820	**45**
2N3822	**65**
2N3823	**65**
2N3866	**90**
2N3903	**18**
2N3904	**18**
2N3905	**15**
2N3906	**17**
2N4037	**46**
2N4058	**10**
2N4061	**10**
2N4062	**10**
2N4427	**80**
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2N4871	**55**
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2N5457	**36**
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3N140	**112**
40313	**130**
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computer kit.

The Sinclair ZX80.

£79.95

Price breakdown
ZX80 and manual: £69.52
VAT: £10.43
Post and packing FREE

Please note: many kit makers quote VAT-exclusive prices.

You've seen the reviews...you've heard the excitement...now make the kit!

This is the ZX80. 'Personal Computer World' gave it 5 stars for 'excellent value.' Benchmark tests say it's faster than all previous personal computers. And the response from kit enthusiasts has been tremendous.

To help you appreciate its value, the price is shown above with and without VAT. This is so you can compare the ZX80 with competitive kits that don't appear with inclusive prices.

'Excellent value' indeed!

For just £79.95 (*including* VAT and p&p) you get everything you need to build a personal computer at home...PCB, with IC sockets for all ICs; case; leads for direct connection to a cassette recorder and television (black and white or colour); *everything!*

Yet the ZX80 really is a complete, powerful, full-facility computer, matching or surpassing other personal computers at several times the price.

The ZX80 is programmed in BASIC, the world's most popular computer language for beginners and experts alike.

The ZX80 is pleasantly straightforward to assemble, using a fine-tipped soldering iron. It immediately proves what a good job you've done; connect it to your TV...link it to an appropriate power source*...and you're ready to go.

Your ZX80 kit contains...
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- Ready-moulded case.
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Optional extras
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- Additional memory expansion boards allowing up to 16K bytes RAM. (Extra RAM chips also available – see coupon).

*Use a 600 mA at 9 V DC nominal unregulated mains adaptor. Available from Sinclair if desired (see coupon).

The unique and valuable components of the Sinclair ZX80.

The Sinclair ZX80 is not just another personal computer. Quite apart from its exceptionally low price, the ZX80 has two uniquely advanced components: the Sinclair BASIC interpreter; and the Sinclair teach-yourself BASIC manual.

The unique Sinclair BASIC interpreter offers remarkable programming advantages:
- **Unique 'one-touch' key word entry: the ZX80 eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.**
- Unique syntax check. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them.
- Excellent string-handling capability – takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The ZX80 also has string input – to request a line of text when necessary. Strings do *not* need to be dimensioned.
- Up to 26 single dimension arrays.
- FOR/NEXT loops nested up to 26.
- Variable names of any length.
- BASIC language also handles full Boolean arithmetic, conditional expressions, etc.
- Exceptionally powerful edit facilities, allows modification of existing program lines.
- Randomise function, useful for games and secret codes, as well as more serious applications.
- Timer under program control.
- PEEK and POKE enable entry of machine code instructions. USR causes jump to a user's machine language sub-routine.
- High-resolution graphics with 22 standard graphic symbols.
- All characters printable in reverse under program control.
- Lines of unlimited length.

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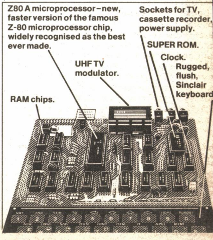
The ZX80 owes its remarkable low price to its remarkable design: the whole system is packed on to fewer, newer, more powerful and advanced LSI chips. A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system, and monitor. And the ZX80's 1K byte RAM is roughly equivalent to 4K bytes in a conventional computer – typically storing 100 lines of BASIC. (Key words occupy only a single byte.)

The display shows 32 characters by 24 lines.

And Benchmark tests show that the ZX80 is faster than all other personal computers.

No other personal computer offers this unique combination of high capability and low price.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SUPER ROM.
Clock.
Rugged, flush, Sinclair keyboard
UHF TV modulator.
RAM chips.

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```
 6 INPUT A(I)
 7 PRINT A(I)
 8 LET I=I+1
10 IF I<N OR I=N THEN GO TO 6
11 FOR X=1 TO N
12 LET B(X)=A(X)
13 NEXT X
14 LET J=0
16 LET J=J+1
18 IF J>N OR J=N THEN GO TO 48
20 LET T=J+1
22 IF NOT A(J)>A(T) THEN GO TO
16
24 LET P=A(J)
26 LET A(J)=A(T)
28 LET A(T)=P
30 LET K=J-1
32 IF K<1 THEN GO TO 16
```

ZX80 software – now available!

See advertisements in Personal Computer World, Electronics Today International, and other journals.

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The Sinclair teach-yourself
SIC manual.

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an little to you – don't worry. They're all
lained in the specially-written 128-page
k *free* with every kit! The book makes
ning easy, exciting and enjoyable, and
resents a complete course in BASIC
gramming – from first principles to complex
grams. (Available separately – purchase
e refunded if you buy a ZX80 later.)
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	Ready-assembled Sinclair ZX80 Personal Computer(s). Price includes ZX80 BASIC manual and mains adaptor.	£99.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	8.95	
	Memory Expansion Board(s) (each one takes up to 3K bytes).	12.00	
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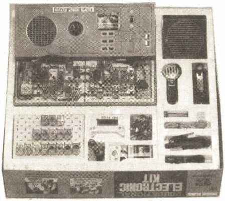

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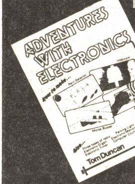

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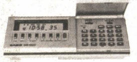

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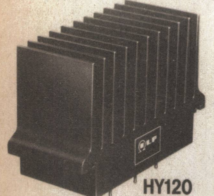

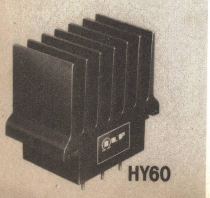

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HY120	60W into 4-8Ω	0.01%	15V/μs	5μs	100dB	£15.20 + £2.28
HY200	120W into 4-8Ω	0.01%	15V/μs	5μs	100dB	£18.44 + £2.77
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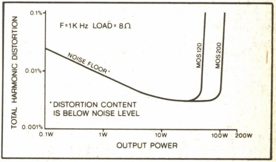
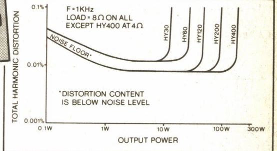


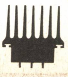
Load impedance both models 4Ω - ∞ Input sensitivity both models 500mV

Input impedance both models 100KΩ Frequency response both models 15Hz-100KHz – 3dB



Load impedance all models 4Ω - ∞ Input sensitivity all models 500mV

Input impedance all models 100KΩ Frequency response all models 15Hz-50KHz – 3dB



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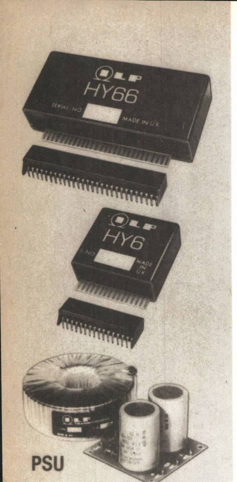

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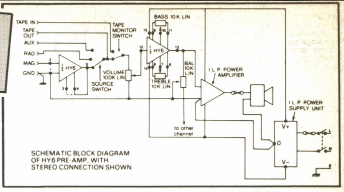

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Projects... Theory... and Popular Features...

The distinction between electronics and electrics is not always clearly understood. And puzzlement amongst the non-technical may well increase rather than diminish in the future as these two closely related technologies become more intertwined. For instance, we already have domestic electrical appliances with electronic controls.

To warrant the description "electronic" a circuit or piece of equipment must depend upon semiconductors or (more rarely today) valves, for its prime function. So an electric toaster remains an electric toaster regardless of the fact that it incorporates a microchip controller.

A simple example of electrics and electronics working together is the control of filament lamps by an electronic timer-switch. A project of this kind is presented this month in the form of a *Tree Lights Flasher*. This device has several advantages over the conventional bi-metal strip type of circuit breaker.

For low level illumination, the electric filament lamp has its electronic rivals. Solid state optoelectronic devices such as 7-segment displays, light emitting diodes and liquid crystal displays are very familiar.

It is thus possible to make a small-scale lighting display that is entirely electronic. Indeed we can see a new art form emerging with the wider use of l.e.d.s to give a special kind of lustre to petite models or ornaments. Our *Table Decoration* is an example. This design simulates a miniature tree as an appropriate feature for Christmas time. But given the circuit, any constructor can use his own ideas to create an alternative model for embellishment with the l.e.d.s.

It is wise to have a game or two up one's sleeve around Christmas time to amuse the youngsters, and others. Childhood memories are likely to be evoked by our electronic version of the old *Stone-Paper-Scissors Game*.

Then there is *Live Wire*. Being essentially electrical (but with electronic trimmings!), this game obviously cannot have an equally long ancestry; although, who knows, a primitive form may have provided incidental amusement for Dr Gilbert, Michael Faraday or some other pioneer during their experiments with this new mysterious force.

We hope some of these projects will play a part in your Christmas. You have four weeks, but don't delay.

Fred Bennett.

Our January issue will be published on Friday, December 19. See page 807 for details.

Readers' Enquiries

We cannot undertake to answer readers' letters requesting modifications, designs or information on commercial equipment or subjects not published by us. All letters requiring a personal reply should be accompanied by a stamped self-addressed envelope.

We cannot undertake to engage in discussions on the telephone.

Component Supplies

Readers should note that we do not supply electronic components for building the projects featured in EVERYDAY ELECTRONICS, but these requirements can be met by our advertisers.

All reasonable precautions are taken to ensure that the advice and data given to readers are reliable. We cannot however guarantee it, and we cannot accept legal responsibility for it. Prices quoted are those current as we go to press.

Everyday ELECTRONICS

VOL. 9 NO. 11 DECEMBER 1980

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• STONE-PAPER-SCISSORS GAME

4 FOR XMAS

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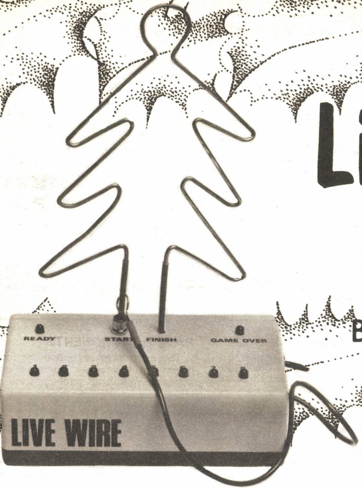
LIGHTS FLASHER •

TABLE DECORATION



Live Wire Game

BY E.M. LYNDSELL

THIS game was designed primarily for amusement at family gatherings, and parties as something to amuse the children but was found to be just as popular with the adults. It could provide entertainment during the forthcoming festive season and perhaps even a Christmas present when ready built or as a kit of parts for the electronic constructor.

NINE LIVES

The idea of moving an eye along a wire from one end to the other trying to avoid the two making contact is not new; however, the "nine lives" addition here is believed to be original. Each touch of the "eye" on the wire sounds a buzzer for a short period and advances a counter one step. This is seen on a string of l.e.d.s on the top panel.

On reaching the last position, your "ninth life" has been used and the game is over. This is signified by the buzzer remaining on until the unit is reset. This is done by moving the eye back to the start position, ready for another attempt.

The unit is powered by a PP3 battery which should have a reasonably long life with moderate use. If prolonged use is envisaged such as at a fête or exhibition a battery eliminator should be considered for reasons of economy and convenience. This would involve the fitting of a suitable socket to the case to suit the eliminator plug, the former connecting directly in place of the battery clip.

Besides its obvious entertainment value, this game could also have a more serious application in gauging a person's co-ordination, i.e. the bidirectional link through the brain between hand and eye.

CIRCUIT DESCRIPTION

The full circuit diagram of the Live Wire is shown in Fig. 1. IC1 is a 555 timer i.c. connected here as a monostable multivibrator. When pin 2 is grounded, i.e. connected to the 0V rail, even for only an instant, the output at pin 3 goes from 0V to +9V for a period determined by the values of R1 and C1. After this time it returns to 0V. This time has been set to be about half a second. Pin 2 is grounded when the eye touches the wire.

While the monostable output is high, TR1 is turned on which places almost the supply voltage across WD1, a solid state buzzer. This emits a tone for as long as the supply is maintained.

The rising and falling of pin 3 level is equivalent to a pulse and this is fed to the clock input of decade counter IC2. Each clock pulse is counted and causes the outputs to switch on the appropriate l.e.d. Thus each time the eye touches the line, the buzzer sounds for a short time and the count is advanced by one.

END OF GAME

This action continues up to the last l.e.d. position, but when this turns on, the high level at pin 11 is coupled to the clock enable, pin 13. While this is low, counting occurs, but when made high, the counting is inhibited. Thus the last position lights and stays alight. Further eye-to-wire contact has no effect.

This high at pin 11 reaches TR1 via buffer R4 and D2, and causes the alarm to sound until reset. Resetting is accomplished by returning the eye to the start end touching it on the phono socket mounted there for this purpose. This takes the reset, pin 15, high, which returns the counter to the READY condition, D3 alight.

Resistor R2 straps IC1 trigger, pin 2, to the positive supply rail making it immune to false triggering from noise spikes etc. R3 affords similar immunity to IC2 reset pin.

CONSTRUCTION starts here

COMPONENTS

Resistors

R1	220kΩ	R4	10kΩ
R2	4·7kΩ	R5	1kΩ
R3	10kΩ	R6	10kΩ

All ¼ watt carbon ± 5%

Capacitor

C1	2μF 6V elect.

Semiconductors

D1, D2	1N4148 small signal silicon diode (2 off)
D3-D12	TIL220 red l.e.d. (10 off)
TR1	BC107 silicon *npn*
IC1	555 timer i.c.
IC2	CD4017 CMOS decade counter/divider

Miscellaneous

WD1	9V solid state alarm
B1	PP3 9V
S1	on/off toggle

Stripboard 0·1 inch matrix size 18 strips × 30 holes; 16-pin d.i.l. i.c. socket; battery clips for B1; coathanger wire; mounting clips for l.e.d.s (10 sets)—optional; flexible wire and paper clip for eye and lead; case, Verobox type 202-21030K or similar.

See Shop Talk page 792

CIRCUIT BOARD

Most of the components were mounted on a small piece of 0·1 inch matrix stripboard size 18 strips × 30 holes.

As a precaution, IC2, because it is a CMOS device, was mounted in a d.i.l. socket to avoid contact with the soldering iron. This is not essential, but advised. Begin by making the necessary breaks on the underside of the board as shown in Fig. 2 including the two board fixing holes. Mount the i.c. socket(s), link wires and other components as shown. Attach sufficient lengths miniature stranded cable to reach the case mounted components when assembled.

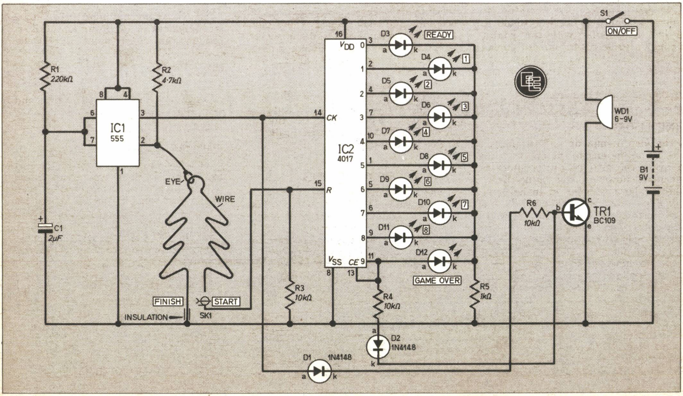
The wire leading to the eye should be the extra-flexible type to be found on test leads as this is very light and durable and will not break as easily as ordinary stranded wiring.

The solid state alarm in the prototype was attached to the circuit board by means of self adhesive foam pads which the author found to be adequate. Insufficient space is available on the existing board layout to use screw fixings for this. Alternatively, the device can be mounted directly to the case by whatever means desired.

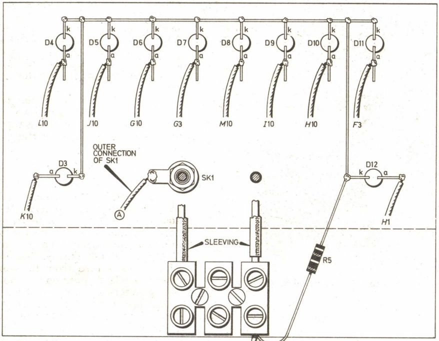
PANEL COMPONENTS

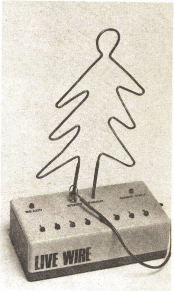
The next stage is to drill the fixing holes for the panel mounted components. Retaining clips or glue for the l.e.d.s on the top panel were not found to be necessary as the holes for these were drilled to be tight and friction held. The exact size of the drill will vary according to l.e.d.s obtained. Alternatively clips or glue may be used. Drill two holes in the

Fig. 1. The complete circuit diagram for the Live Wire Game.



Live Wire Game





Photograph above shows an external view of the game. The shape of the wire and loop and also SK1 can be clearly seen.

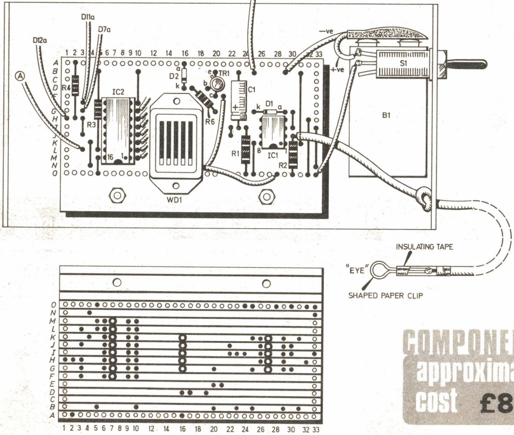
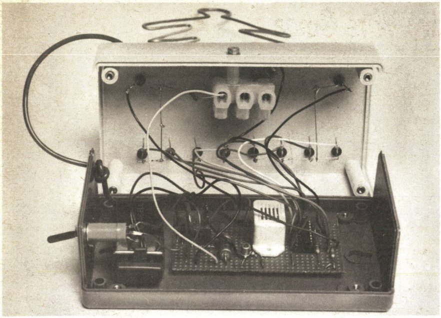


Fig. 2. Shows the layout of the components on the topside of the stripboard, breaks to be made on the underside and complete interwiring.

COMPONENTS
approximate cost £8



The completed prototype prior to the case being screwed together.

case a distance apart to suit the parallel ends of the "Wire" shape. In the prototype this was made from coathanger wire, bent to resemble a Christmas Tree so as to be topical at this time of year.

A phono socket was found to be a convenient method for bringing the reset connection to the front panel around the Wire at the start end, the earth tag being used for this purpose. A screw type terminal block was found to be a suitable clamp for the Wire shape and was mounted to the case side via threaded spacers. Short lengths of sleeving cover the ends of the Wire to provide non-active or safe regions at the start and finish.

Fit the board to the case and the Wire to the terminal block and then this to the case, not forgetting the connection to be earth tag on the phono socket.

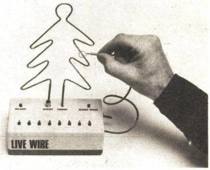
With all the l.e.d.s fixed in position and their cathodes (k) aligned, a busbar can be soldered to the array as seen in Fig. 2 followed by the appropriate lead from the board to each of the l.e.d. anodes. Fix the on-off switch in position and connect to the remaining battery lead and complete the interwiring as shown. A knot was tied on the external lead prior to passing through a small hole in the case end. This is in order in this low voltage wire and prevents any stress at its soldered location on the board.

The eye was constructed from a paper clip formed with a pair of pliers, see Fig. 2. The eye diameter was made slightly larger than the phono socket and this was found to be a suitable size for the Wire tree made from a metal coathanger as mentioned earlier. A piece of coloured tape over the solder connection of the paper clip/lead enhances the appearance and provides a suitable handle for the eye.

It only remains to fit the battery and label the unit as shown in the photographs. A self-adhesive foam pad was used to secure the battery to the case.

PLAYING THE GAME

The object of the game is to move the eye from start to finish without touching the Wire. Each touch will be recorded and signalled by the buzzer sounding for a short time and an l.e.d. illuminating respectively. The number of touches is read from the numeral above the l.e.d. position as shown in the photographs. On the ninth however, the last l.e.d., labelled **GAME OVER**, remains lit and the buzzer sounds until reset; the latter occurs when the eye touches the phono socket, or the unit is switched off. ⌑



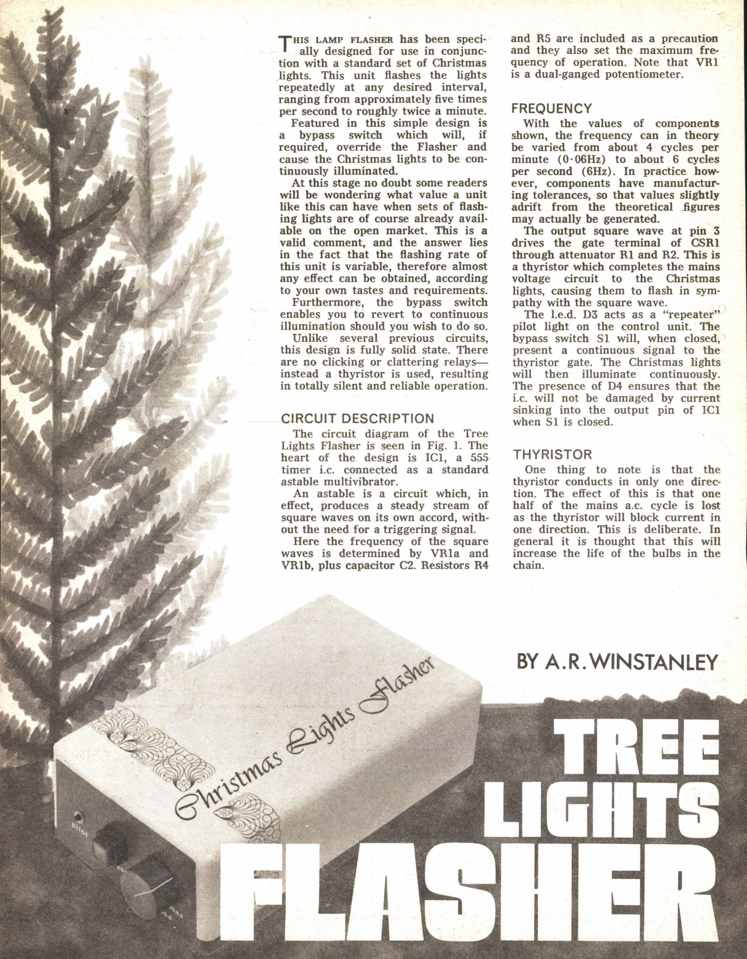
JACK PLUG & FAMILY...

BY DOUG BAKER

PLUG, I HEAR YOU'VE BEEN WORKING ON ELECTRONIC PROJECTS DURING WORKING HOURS AND I WILL NOT HAVE YOU MIXING BUSINESS AND PLEASURE.
SORRY, SIR, IT WON'T HAPPEN AGAIN. FROM 'NOW' ON I'LL CONCENTRATE ON PLEASURE.

TREE LIGHTS FLASHER

BY A.R.WINSTANLEY



THIS LAMP FLASHER has been specially designed for use in conjunction with a standard set of Christmas lights. This unit flashes the lights repeatedly at any desired interval, ranging from approximately five times per second to roughly twice a minute.

Featured in this simple design is a bypass switch which will, if required, override the Flasher and cause the Christmas lights to be continuously illuminated.

At this stage no doubt some readers will be wondering what value a unit like this can have when sets of flashing lights are of course already available on the open market. This is a valid comment, and the answer lies in the fact that the flashing rate of this unit is variable, therefore almost any effect can be obtained, according to your own tastes and requirements.

Furthermore, the bypass switch enables you to revert to continuous illumination should you wish to do so.

Unlike several previous circuits, this design is fully solid state. There are no clicking or clattering relays—instead a thyristor is used, resulting in totally silent and reliable operation.

CIRCUIT DESCRIPTION

The circuit diagram of the Tree Lights Flasher is seen in Fig. 1. The heart of the design is IC1, a 555 timer i.c. connected as a standard astable multivibrator.

An astable is a circuit which, in effect, produces a steady stream of square waves on its own accord, without the need for a triggering signal.

Here the frequency of the square waves is determined by VR1a and VR1b, plus capacitor C2. Resistors R4 and R5 are included as a precaution and they also set the maximum frequency of operation. Note that VR1 is a dual-ganged potentiometer.

FREQUENCY

With the values of components shown, the frequency can in theory be varied from about 4 cycles per minute (0·06Hz) to about 6 cycles per second (6Hz). In practice however, components have manufacturing tolerances, so that values slightly adrift from the theoretical figures may actually be generated.

The output square wave at pin 3 drives the gate terminal of CSR1 through attenuator R1 and R2. This is a thyristor which completes the mains voltage circuit to the Christmas lights, causing them to flash in sympathy with the square wave.

The l.e.d. D3 acts as a "repeater" pilot light on the control unit. The bypass switch S1 will, when closed, present a continuous signal to the thyristor gate. The Christmas lights will then illuminate continuously. The presence of D4 ensures that the i.c. will not be damaged by current sinking into the output pin of IC1 when S1 is closed.

THYRISTOR

One thing to note is that the thyristor conducts in only one direction. The effect of this is that one half of the mains a.c. cycle is lost as the thyristor will block current in one direction. This is deliberate. In general it is thought that this will increase the life of the bulbs in the chain.

The power for the i.c. oscillator is derived from a standard full-wave arrangement, in which mains voltage is stepped down by T1, rectified by D1 and D2 and then smoothed by C1 to produce a d.c. output of about 9V.

In this design, no part of the circuit must be earthed. Only a live and neutral input is needed and no earth will be required.

COMPONENTS

COMPONENTS approximate cost £11·00 excluding case

Resistors

R1	680Ω
R2	100Ω
R3	560Ω
R4	4·7kΩ
R5	4·7kΩ

All ¼W carbon ± 5%

Capacitors

C1	1000μF 16V elect. axial mounting
C2	15μF 16V elect. axial mounting

Semiconductors

IC1	NE555 timer i.c.
CSR1	C106D 400V 4A thyristor
D1,2	1N4001 50V 1A silicon rectifier diode (2 off)
D3	TIL209 red l.e.d.
D4	1N4001 50V 1A silicon rectifier diode

See **Shop Talk** page 792

Miscellaneous

VR1	470kΩ lin. dual ganged potentiometer
T1	mains primary, 6-0-6V 100mA secondary
S1	single pole, push-on, push-off switch
FS1	1A 1¼ inch cartridge fuse and panel mounting holder.

Case, 188 × 110 × 60mm, Verobox 65–2522K or similar; printed circuit board, 75 × 50mm; four-way 5A screw terminal block; 8-pin d.i.l. socket for IC1; panel clip for D3; knob; 4BA and 6BA nylon nuts and bolts; twin core 3A mains cable; 3A cable and light gauge wire for internal connections; grommets (2 off).

CONSTRUCTION starts here

CASE

The housing used for the prototype of this project is a standard all-plastic Verobox type 202-2103G, measuring 188×110×60mm. A metal or part-metal case should not be used.

The components themselves are mounted upon a 75×50mm printed circuit board, see Fig. 2. A glass-fibre p.c.b. is preferred since this has much greater strength than s.r.b.p.

There is a mixture of both low d.c. and mains a.c. voltages on the board, and so if you etch your own p.c.b., take extreme care as errors or flaws could have unexpected and dangerous results to say the least.

Solder all the components onto the p.c.b. as shown. The majority of parts are polarity sensitive so insert them the right way round. Use an 8-pin d.i.l. socket to carry IC1. Do not forget to solder in the small link wire. This can be made from 22 s.w.g. tinned copper wire.

On one edge of the box are mounted the l.e.d. D3 (use a panel clip), the bypass switch and the dual potentiometer, which should be fitted with an all-plastic knob.

The other end carries the panel-mounting fuseholder (which should be of an approved safety type) and the cable inlet. The mains input cable should pass through a grommet in the case and be fitted with a cable retaining clip so that it will not pull out.

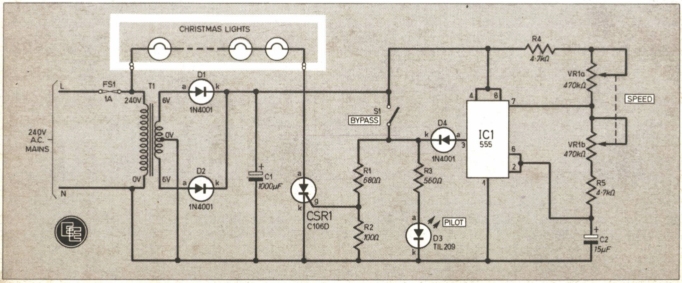
CHRISTMAS LIGHTS

Connections to the Christmas lights are made at a four-way terminal block. The flex from the lights passes through a grommeted hole adjacent to the fuseholder to the appropriate terminals on the block. The terminal block also carries further connections for the transformer as illustrated.

The interwiring diagram is shown in Fig. 2 and this is largely self-explanatory. Do not overlook the subsidiary interwiring between the tags of VR1. Use Veropins on the p.c.b. where flying leads are taken off. Make sure that all mains wiring is of an adequate rating. The minimum should be 3A.

All fittings must be bolted down with non-conducting nylon hardware. Do not overtighten the nylon nuts because it is quite easy to strip the threads.

Fig. 1. Complete circuit diagram of the Tree Lights Flasher.



TREE LIGHTS FLASHER

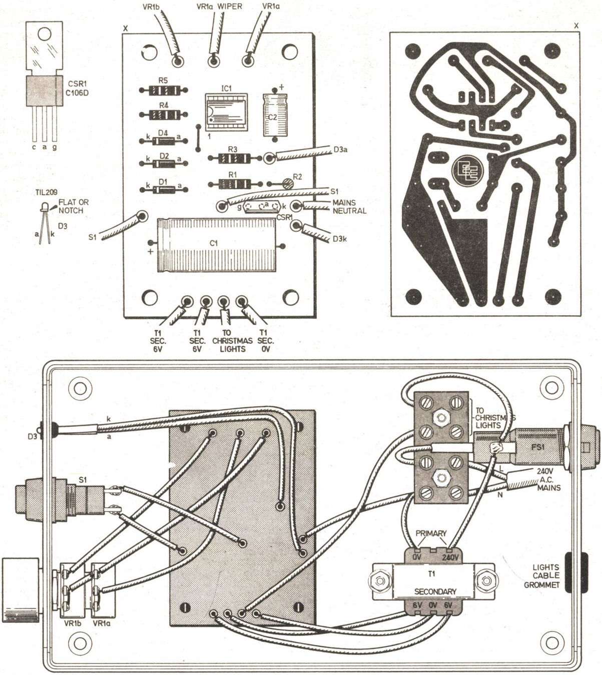
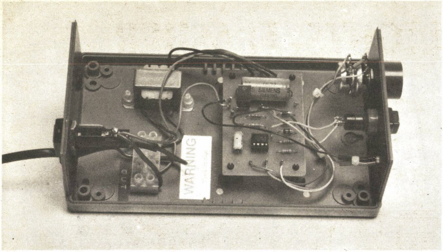


Fig. 2. Circuit board layout and interwiring details. Note that the lights are attached directly to the terminal block. Their cable should be secured inside the case once it has been connected up. If an alternative case is used, this *must* be an all plastic type.



The completed unit with the lid removed. The circuit board and associated components can be seen quite clearly. At this stage the lights have not yet been attached.

Should you wish to letter the case, do this before any parts are fitted down onto the box. Use rub-down dry transfer lettering, and then carefully apply a couple of coats of protective lacquer.

SETTING UP

With construction complete, thoroughly check out all the wiring. Do not connect up the Christmas lights yet, but set VR1 fully clockwise for maximum speed.

Plug the unit into the mains and switch on. The pilot l.e.d. should be flashing rapidly. If it is continuously alight then check whether S1 has been closed.

Rotating VR1 gradually anti-clockwise should reduce the speed of the flashing. If this is so then completely unplug the unit and then feed the flex from the lights through the hole in the case, secure the cable and then connect it to the output terminals of the terminal block. Close up the case and then switch on.

The Christmas lights should be flashing at a speed determined by VR1. A slight flickering may just be detectable in some cases. This is unavoidable and is caused by the rectifying action of the thyristor.

The range of speeds available on individual models may not suit the constructor. By replacing C2 it is possible to adjust the general frequency range. Increasing C2 will slow down the flasher, and vice versa. The capacitor value should lie between 10 microfarads and 47 microfarads, but no doubt experimentation will produce the best compromise. ¤

COUNTER INTELLIGENCE

By PAUL YOUNG

Friendly Dealer

I have, in each of my last two articles, delivered a small homily on ordering components and hope that my suggestions have proved useful. Just to wrap up the subject for another year I will only add this.

Your average component dealer is not in it, as a way to riches, as I have said previously, if this were so, he would do better selling fish and chips. He is in the business because he is an electronics enthusiast. It therefore follows that he will help a fellow enthusiast whenever he is able to do so.

Naturally, it is only fair to confine your questions mainly to the supply of electronic components, but if in difficulty don't hesitate to call in your friendly component dealer. You will find he is more helpful than your friendly Bank Manager and he doesn't pop out of the bedroom wardrobe and make a pass at the wife.

I do very occassionally like to mention our problems, if only to justify why we cannot always give the service we would like to. For example, in the last 12 months there has been a growing tendency for our suppliers to put up the value of the minimum order they will accept.

For several years, many firms have been insisting on a minimum order of £20 to £25, but lately, no doubt due to pressure from some of their bright accounting boys, they have pushed it up to £75 and £100. Now the poor old dealer who wants a dozen knobs, might stretch a point and go to £20 or £25's worth but £75 or £100's worth is out of the question and the nett result is, that another item disappears from his stock.

I know the accountants can make out a good case for it but I am not yet convinced that it is not a short sighted policy.

Electric Car

We all like to indulge in a little fantasy sometimes and I like to imagine one day opening my copy of EVERYDAY ELECTRONICS and seeing a constructional project for an *Electric Car!* I expect by the time that happens, I shall be driving a medium sized cloud, or be solely dependent on wing power.

Perhaps that is being unduly pessimistic, because already in the States one of the oil companies has developed a car that will do 55 miles per hour and cover 250 miles at a charge. The running costs should be pennies and with no gear box or clutch, the maintenance costs should be much lower. Within a year the company hope to be turning out 100 units a week and they estimate the potential market as being around 230 million!

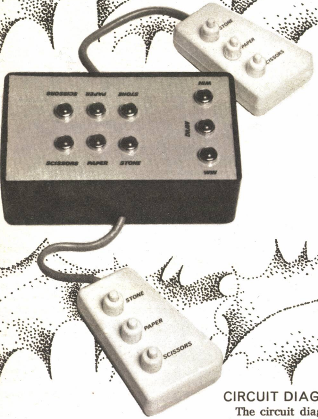
The L.E.B. were given the job, a few years ago, of evaluating the Electric Car, admittedly using the old type of lead acid battery, and my brother, who is in communications, had one to try out. He told me it was quite a fun thing to drive and there was no worry about starting on a cold morning or frozen radiators, the acceleration was unbelievable, in fact there was only one thing that he found disconcerting. To reverse you simply pulled out a small knob on the dash board and you could go as fast backwards as forwards!

Sweeping the Air

I have been doing some research prior to writing an article, on the radios used by prisoners of war, in places like Colditz. I am very fortunate in having a friend in the Imperial War Museum, but while I was intrigued at the ingenuity shown in hiding the illicit receivers (one was hidden in a false broom head used to sweep out the compound, another in a shoe with a false bottom) I was surprised at the construction.

I thought they would be made out of old cocoa tins from Red Cross parcels. Instead, I found they had German valves and transformers in them, which looks as though there must have been a little bribery and corruption taking place.

I feel sure there are many stirring tales still to be told and in this connection I am still very short on many details, so if any of our readers can help me, I should be most grateful.



Stone-Paper Scissors Game

BY E.M. LYNDSELL

MANY games are played in school during break-time (and in class-time) but one that remains in the authors mind is called Stone-Paper-Scissors.

This is played by two people using hand signs to represent each of the above articles. A fist denotes stone, two pointing fingers, scissors, and an open hand, paper. The idea is to produce one of these signs at the same time as your opponent. Paper will wrap a stone, so paper wins; stone blunts scissors, so stone wins; and to complete the ring, scissors cut paper so scissors win. The first one to reach five individual wins (a draw not counting) is the overall victor.

At first it is pure guess-work attempting to beat your opponent, but as the game progresses, and information is gathered, by both players regarding their own "play" and that of their opponent, it becomes a contest of the mind.

In the project to be described here, the hand signs have been replaced by push-button switches, and a display panel shows the sign that has been played and indicates by means of a lit bulb who has won, or a draw if this occurs.

CIRCUIT DIAGRAM

The circuit diagram of the game is shown in Fig. 1. As shown the upper section of player *A*'s switches are matrixed in all combinations with the same sections of player *B*'s switches. Only when both players push a switch do any lamps light up.

The transistors act as electronic switches that only turn on when two specific conditions are met. These are a positive voltage on the base terminal and a negative voltage on its emitter terminal. For example, if player *A* presses S3, a positive voltage appears on the base of TR4, TR8 and TR3 via steering diodes D2, D6 and D7 and current limit resistor R1. If player *B* now operates switch S5, the battery negative plate is connected to the emitter of TR4, TR5 and TR6. The only transistor where both conditions are met is TR4. Consequently, this transistor turns on. Its collector falls to near battery negative voltage causing LP4 to light and indicate that player *A* has won.

Also, when these two switches are made, the circuit containing LP3 and LP8 and the battery is completed

COMPONENTS

Resistor

R1	1kΩ ¼W carbon ± 5%

Semiconductors

D1-D9	1N4148 or similar silicon type (9 off)
TR1-TR9	BC107 silicon *npn* (9 off)

Switches

S1-S6	double-pole push-to-make, release-to-break (6 off)

Miscellaneous

B1	9V type PP3, PP6, PP9, 1289 (2 off)—see text.
LP1,2,3,7,8,9,	6V 60mA m.e.s. bulbs (6 off)
LP4,5,6	12V 60mA m.e.s. bulbs (3 off)

Stripboard: 0·1 inch matrix size 18 strips × 30 holes; panel mounting m.e.s. lampholders (9 off); battery clips to suit B1; 6BA hardware; cases (3 off) see text; 7-way miniature cable (stranded preferred) length to suit.

See Shop Talk page 792

resulting in these lamps lighting up on the display panel. If either player for any reason presses two switches this is immediately detected by two of his switch status lights coming on as well as two lamps from LP4, LP5, and LP6 being lit.

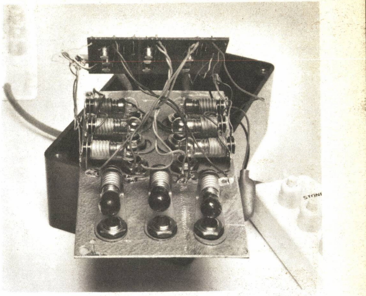
To produce equal illumination from all lit lamps, the voltage rating of the status lamps is half that of the result lamps. The voltage of the battery may be varied to suit the bulbs obtained and required intensity with their current rating of course less than the maximum current capabilities of the transistors, which for the BC107 is 100mA.

CONSTRUCTION starts here

CIRCUIT BOARD

A small piece of stripboard size 0·1 inch matrix, 18 strips by 30 holes holds all the diodes, transistors and the resistor. See Fig. 2 for the layout details and the breaks to be made on the underside. As most of these components are semiconductors, care should be taken when soldering them in place as they can be damaged by the heat from the soldering iron. The link wires should be connected first. Attach suitable lengths of lead to reach the case mounted components.

The case used in the prototype was plastic with a metal lid with dimensions of 160 ×95×50mm. With the lamp holders used, there was little room in the case after assembly, so these dimensions should be regarded as the minimum required.


Shows the completed prototype before final assembly.

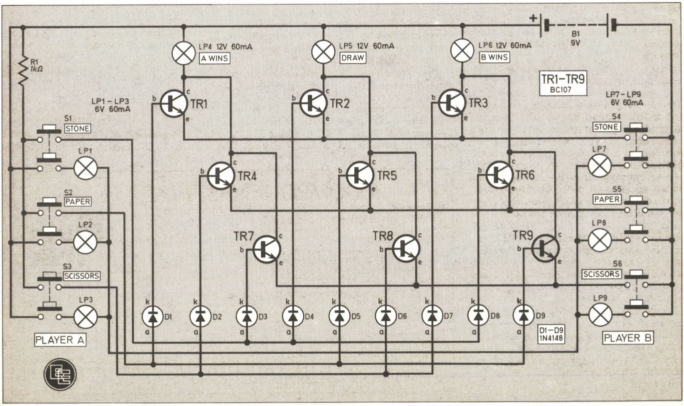
LAMPHOLDERS

Prepare the lid to accept the nine lampholders and fit into position and interwire as shown in Fig. 2. Next wire these to the component board. The two cases for holding the push-button switches should next be drilled and the switches fitted and interwired.

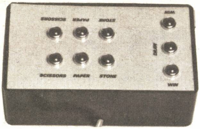
Connect a suitable length of 7-way cable to each bank of switches and feed the other end into the main case through a small hole drilled halfway along the case side near to the base. Sufficient length of outer sheath should be removed to allow the wires to be fitted to the component board and lampholders when the lid is removed from the case. Cable fixings are recommended to avoid strain on the wiring when in use. Finally solder on the battery connector and fit the board to the base of the case.

If a plastic case is used no spacers or insulation need be used between board and case when the board is bolted in position. Connect a battery,

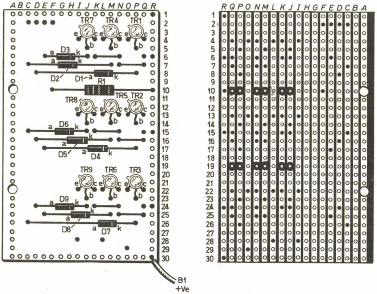
Fig. 1. The complete circuit diagram for the Stone-Paper-Scissors Game.

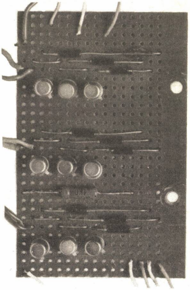


Stone-Paper Scissors Game

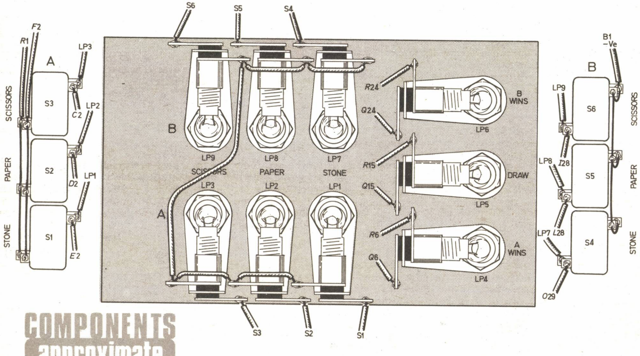


The completed unit showing labelling on the front panel.



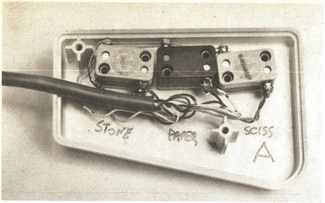


Close-up view of the prototype component board.



COMPONENTS
approximate cost £6·50
excluding case

Fig. 2. Shows the position of the lampholders on the rear face of the top panel and wiring to the component board and remote switches. The layout of the components on the board and the breaks to be made on the underside are seen top left.



Position and inter-wiring of the switches in player *A*'s control box.

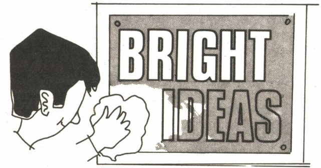
sticky tape or adhesive foam sponge will hold it in place, fit the lid and the unit is ready to play.

TESTING AND PLAY

First of all label all the switches and lamps as shown in the photograph. Check all of the switch status lamps by holding down simultaneously a switch from each player's box in the nine different combinations. Check that the labelling between lamp and switch agrees. Finally check that the result lamps give the right answer for each of the combinations according to the rules outlined in the opening paragraphs.

The two players should sit opposite each other with the unit between them. Each player should then press one of their switches not letting their opponent see which one has been operated of course. If the win lamp on your side lights, then you have won that particular round.

A PP3 battery will provide power for a moderate length of time with the current drawn by the lamps since this is only required for short lengths of time. For prolonged use, you are advised to use a more substantial battery e.g. a PP6 or PP9 or two 4·5V bell batteries connected in series. A larger case will be required in these instances. Alternatively, a socket may be fitted in place of the battery clips to enable power to be supplied by a battery eliminator.



Readers' Bright Ideas; any idea that is published will be awarded payment according to its merit. The ideas have not been proved by us.

DRILLING TEMPLATE

To assist in drilling holes for component leads in p.c.b. boards, I use a piece of Perspex about 5mm thick with holes drilled at spacings suitable for i.c.s and presets.

Positioning of the Perspex over the copper areas is easy as the p.c.b. pattern can be seen through the Perspex.

During drilling the Perspex is held in place with a spring clamp.

H. G. Hartog,
Maungarati,
New Zealand

COMPONENT STORAGE

There are various ways of storing components, but transistors bring a very big problem since, there are a lot of types and it is rarely found that one has more than five of the same type. These are often difficult to store and locate. I thought that small cases would solve the problem so that the transistors could be stored in drawers or boxes. In looking for an ideal small case I found that the small cases of Instamatic camera flashes are ideal. You just carefully remove the bottom part (which will eventually form the lid) and then remove the used flashes. This can be used as a small case.

Pierre Mallia,
Santa Lucia, Malta

L.E.D. HOLDER

Sometimes l.e.d.s are difficult to mount into a display panel. This problem can be simply alleviated by using a rubber grommet as a l.e.d. holder.

The grommet chosen should have an internal diameter slightly less than that of the l.e.d. and is first mounted in the panel in the usual way.

The l.e.d. can then be pushed through from behind and is held tightly. The end result gives a pleasing appearance.

David Hall,
Selby, West Yorkshire

SPEAKER CLOTH

Lately when faced with the problem of what to use as a speaker covering in a small project, I came up with the following solution.

I purchased a new potato sack and cut out a piece. This was then glued in place over the aperture in the case and the speaker glued on top of it.

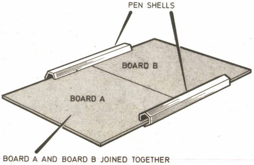
The end result looked very professional and the sound escapes quite freely through the tiny holes in the fabric.

R. Mountford,
Shaftesbury, Dorset

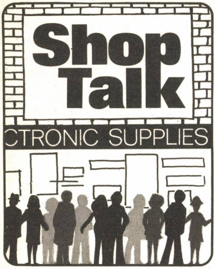
CIRCUIT BOARD JOINER

I have found an inexpensive way of joining two circuit boards together by using the shells of exhausted ball-point pens of the disposable type. Start by cutting a slit down the pen case and then simply slide it along the sides of the circuit boards and across the join to hold them together.

Irwan Owen (aged 14),
Cobham, Surrey



BOARD A AND BOARD B JOINED TOGETHER



By Dave Barrington

Component Buying

Before looking at the first influx of the new seasons catalogues we should like to make a couple of points about component buying.

The majority of constructors obtain their components by mail order. Therefore, the first step should be to obtain at least three or more catalogues from different advertisers.

The charge from these varies from a few pence upwards to approximately one pound. Sometimes the outlay for catalogues is redeemable with component order vouchers.

It is important to study these catalogues as it will help the constructor to familiarise himself with components and typical sizes and values usually stocked. Also, it can save money in the long run.

When ordering from a catalogue always follow any instructions contained therein. Most contain an order form on which the stock number, quantity and price should be entered clearly. To help cut down on the number of mis-directed parcels always print name, address and post code in block capitals.

If an order form is not supplied, always follow the recommendation given in the particular Components List contained in the published article and use types specified. If in doubt, cut out the list or better still make an exact copy and send this to the advertiser, including the title of the project and issue date it appeared.

Catalogues

We have often used the name of Maplin when recommending a standard for components catalogues and a mail order service *par excellence.*

For those not in possession of their latest 280 page components catalogue (price £1·16 including post and packing) we strongly recommend you do so. If W. H. Smiths consider it good enough to sell through their shops (price £1·00), it must be better than average.

As a back-up to their catalogue they issue regular editions of a *Newsletter/Price List.* This can contain up to 30 pages of latest information on prices, new lines and special bargain offers. To be added to their mailing list cost only 30p and is well worth the investment.

Another catalogue that is a must for constructors is the Home Radio Components catalogue. Their latest edition contains 80 pages, lists over 2,000 items and costs £1·00 plus 50p postage and packaging.

Apart from the usual stocks of standard items like soldering irons, printed circuit board kits, semiconductors and cases, Magenta Electronics latest 52 page catalogue contains details of complete kits for many past projects published in this magazine.

Like most of our advertisers they issue separate price lists throughout the year.

Copies of the Magenta 1980/81 Catalogue can be obtained by sending six 10p stamps to Magenta Electronics Ltd., Dept EE, 98 Calais Road, Burton-on-Trent, Staffs DE13 0UL.

If it's tools you are looking for, then the 12-page catalogue from TRI-tronic Marketing Ltd may prove useful.

This catalogue lists an excellent range of side-cutters and pliers. For the constructor they have put together a "basic starter" tool kit in a plastics tool box. Included in the kit is a soldering iron and stand.

Copies of the Electronic Tools and Equipment Catalogue are available free from TRI-tronic Marketing Ltd, 75 Albert Street, Rugby, Warks CV21 2SN.

Coinciding with their move to larger premises, the latest components catalogue from Ace Mailtronix contains over 1000 stock items.

The catalogue is available now, price 30p, to mail order customers. This charge is refundable with subsequent orders over £5.—The catalogue is free to callers!

Note Ace Mailtronix new address is: Ace Mailtronix Ltd., 3A Commercial Street, Batley, W. Yorks WF17 5HJ.

Late News

We have just heard that Watford Electronics are about to launch their new components catalogue.

This will be a 100 page effort printed on top quality paper and contain over 6,500 off-the-shelf items. The catalogue is lavishly illustrated and expected to sell for approximately 75p, including postage.

CONSTRUCTIONAL PROJECTS

Springline Reverberation Unit

The one project this month that looks as though it is going to cause most readers component sourcing difficulties will be the *Springline Reverberation Unit.*

The springline module used in this project is the Maplin XB84F Long Spring Line. Because of its overall physical dimension of 432mm long it makes any suitable commercial case, to house the circuit board and springline, fairly expensive.

As there seems ample room in the prototype layout for plenty of space saving, one possible answer would be to purchase some aluminium sheet and bend it to form a U-shape chassis; one side forming the front panel and the other the back. The circuit board could be mounted on the front or back panel.

To complete the case, the chassis can be surrounded with a wooden (battens) framework covered with hardboard or veneered plywood.

When ordering the transistor TR1 be sure to specify the **L** in BC184L. The leadout configuration for the BC184 is in a different order.

Two Note Door Chime

The next on our list for particular care when purchasing components is the *Two Note Door Chime.*

It is most important that for IC2 the CD 4011**A** (without static protection) be used. The CD4011B is *not* suitable as the static protection circuits incorporated in this i.c. prevent proper operation of the tone generators.

We have ascertained that Watford Electronics are able to supply the CD4011A.

It is also necessary to use tantalum capacitors where specified in the circuit because of their excellent low leakage factor.

Be extra careful when handling the CMOS i.c.s and only insert them in their sockets when all wiring is completed and the unit is ready for testing.

No Entry Indicator

The first in our new *I.C. Uniboards* series covering simple integrated circuit (i.c.s) designs is the *No Entry Indicator.*

Most of the components should be readily available, but the Hekla rocker switch S1 would appear to be only listed by Maplin Electronic Supplies.

Paper-Scissors-Stone Game

Only the push switches called for in the *Stone-Paper-Scissors Game* are special to this project. These are the Castelo double-pole push-to-make, release-to-break types stocked by Electrovalue.

Of course, any similar action types may be used but those listed were chosen for their price.

Tree Lights Flasher

All components for the *Tree Lights Flasher* are standard items and should be stocked by most component suppliers.

Looking through the advertisement pages we see that Micro Circuits are currently offering the C106D thyristor at a special price of 30p each.

Table Decoration

The integrated circuit used in the oscillator section, ICI, of the prototype version of the *Table Decoration* is the CD4001AE. As we have been unable to try the B series, with static protection, we strongly recommend that readers purchase a device with the suffix AE as incorrect operation of the oscillator may be experienced with the "B" devices.

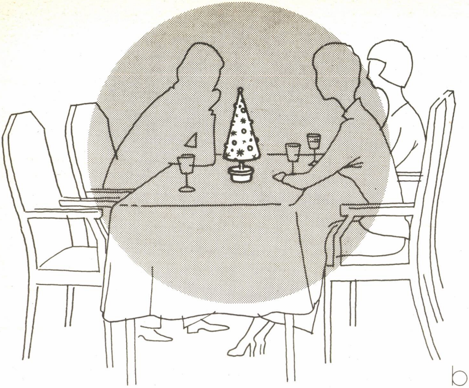
The prototype model used the MM74C-174, but we have specified the CD40174 as this appears to be more readily available.

Breadboard Exhibition

If you would like to see some of this month's, past and *future* projects in operation, why not pay us a visit at the Breadboard '80 exhibition.

Everyday Electronics will be exhibiting on Stands *J7* and *J8*. Amongst our displays for the future will be an Ultrasonic Intruder Detector and a Horse Racing Game. —Come and try your luck!

The Breadboard '80 show is being held at the Royal Horticultral Halls, Elverton Street, Westminster, London, SW1 from 26 to 29 November.



by A. P. DONLEAVY

table decoration

THIS article describes the construction of a decoration which uses an arrangement of l.e.d.s turning on and off to provide the attraction. The external design can be altered to suit the artistic taste of the constructor, as can to some extent, the electronic sequence. The electronic part of the project is easy to make, and the finished product can be effective, giving the constructor and his family a novel decoration for the imminent festive season.

CIRCUIT DESCRIPTION

The sequence of events is such that the l.e.d.s turn on progressively in four groups until all are lit. The display then extinguishes itself for several seconds after which the l.e.d.s start to light again. The circuitry to achieve this is shown in Fig. 1.

IC2 contains six bistable flip-flops, four of which are used to drive the l.e.d.s. The operation of the flip-flops is as follows. Each flip-flop has two inputs, a data (*D*) and a clock (*CK*) input. When a positive pulse arrives at the clock, the output goes to the same state as the data input, e.g. if the data is at logic 1, then the output will also go to logic 1 when the next clock pulse arrives.

In this circuit the data input of each flip-flop is connected to the output of the preceding one, with the exception of the input of the first flip-flop in the chain which has its input strapped to the +ve supply rail via R4. Thus as each flip-flop turns on, it provides the logic 1 state to the next flip-flop data input to turn on with the following clock pulse.

IC1 contains four CMOS NOR gates. Two of these gates, IC1a, IC1b, are connected as an oscillator to provide the

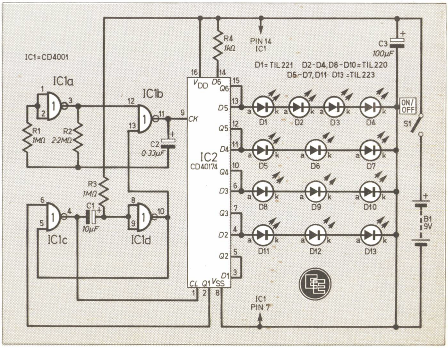
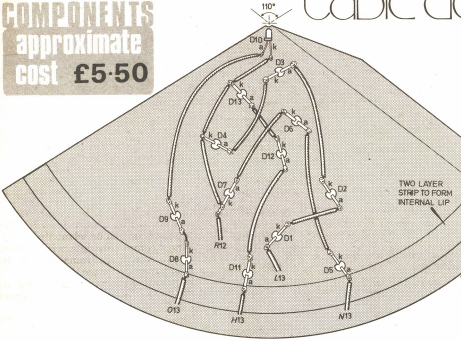
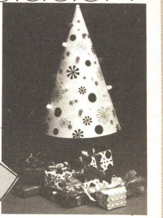


Fig. 1. The circuit diagram of the Table Decoration.

COMPONENTS approximate cost £5·50

table decoration





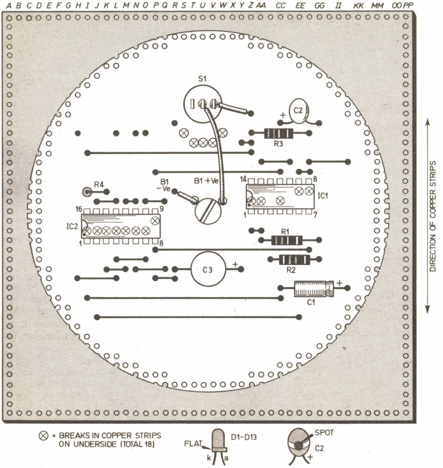


Fig. 2. Top shows "development" of cone drawn half-scale with l.e.d.s positioned to give a display half-way round the cone which will appear similar to the display seen on the front cover. The l.e.d.s should be interconnected using lightweight stranded wire for ease of assembly.

The prototype model used a circular board, sawn and filed to shape. Other model shapes may allow a square or rectangular board to be used.

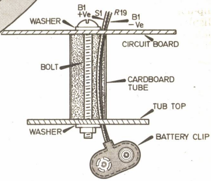


Fig. 3. Means of supporting the circuit board and paper tree using a hollow "tree trunk".

COMPONENTS

See **Shop Talk** page 792

Resistors
R1 1MΩ
R2 2·2MΩ
R3 1MΩ
R4 1kΩ
All ¼ Watt carbon 5%

Capacitors
C1 10μf 10V elect.
C2 0·33μf 10V tantalum bead
C3 100μF 10V elect.

Semiconductors
IC1 CD4001 CMOS Quad dual-input NOR Gate
IC2 CD40174 CMOS Hex D-type flip-flop (or MM74C174)
D1 TIL221 0·2 inch green l.e.d.
D2-D4, D8-D10 TIL220 0·2 inch red l.e.d. (6 off)
D5-D7, D11-D13 TIL223 0·2 inch yellow l.e.d. (6 off)

Miscellaneous
B1 9V PP3—see text
S1 on/off miniature toggle switch
Stripboard: 0·1 inch matrix 38 strips × 38 holes circular—see text; 14-pin d.i.l. socket; 16-pin d.i.l. socket; battery clip or socket—see text; lightweight stranded wire 22 s.w.g. tinned copper wire; materials for decoration.

clocking pulses. The period of oscillation is determined by the values of C2 and R2. The shorter this period, the faster will be the rate at which the l.e.d.s light-up, and also the shorter the total duration of the display. The output from the oscillator, pin 11 IC1, is fed to the clock input of IC2, pin 9. All six flip-flops of IC2 have a common clock.

IC1c, IC1d are connected as a monostable which is used to provide the timing interval between the display turning off and starting again. One input (pin 6) of IC1c is connected to the output of the last flip-flop in the chain, *Q1*. When this turns on the monostable produces a positive pulse at pin 10 which is applied to IC1b, and stops it from oscillating. Also at this time the output of IC1c goes high and this is applied to the clear pin on IC2 which resets all the outputs of the flip-flops to logic 0. This turns off the display. The values of R3 and C1 determine this off period. At the end of the monostable pulse, the oscillator starts again, and the sequence repeats.

COMPONENTS

The voltage drop across an l.e.d. when illuminated will vary according to its semiconductor material. In the prototype, red and green l.e.d.s with a voltage drop of 2 volts and yellow ones having a drop of 2·2 volts were used. Reasonable intensity was produced with a current of about 3mA.

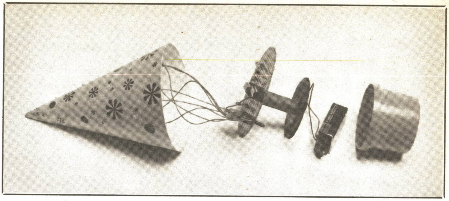
When using a 9 volt battery, the output voltage level of each flip-flop in IC2 is just over 8 volts when supplying a current of about 3mA. This therefore sets the number of l.e.d.s that can be wired in series with each flip-flop output to a maximum of four red or green or three yellow types with specifications as stated above. Other varieties are available with different voltage drops so this parameter is important.

L.E.D.s

The minimum number of l.e.d.s that can be connected in series must not be less than three in the circuit of Fig. 1 unless a series current limit resistor is included in its group, otherwise IC2 may be permanently damaged.

The number of l.e.d.s in the total display may be increased by adding another group connected to the unused flip-flop output (Q2). As well as this, the number of l.e.d.s in each group may be increased by running the system at a higher voltage bearing in mind the restrictions regarding output current and l.e.d. voltage drops mentioned earlier. Not more than 1·5 volts should be left to be "dropped" by flip-flop internal output circuitry.

Decreasing the values of C1 and/or R3 will decrease the off time of the l.e.d.s. However this will also reduce the battery life. With the values given the off period was about 10 seconds.



An exploded view of the near completed prototype.

CONSTRUCTION starts here

ASSEMBLY

Begin by mounting the sockets which provide landmarks for the link wires that should be assembled next followed by the other components. Pay attention to capacitor polarities. Do not attach any flying leads for the l.e.d.s at this juncture.

The development of the cone is shown in Fig. 2. This is shown half scale. The position of the l.e.d.s shown here will produce a display similar to that shown in the photographs when the cone is rolled and glued together. You will notice that the display only occupies half the cone surface area. If you want coverage over the whole surface more l.e.d.s will be required otherwise they will be too spaced out. More l.e.d.s may be added as described earlier.

CONE

It is advised that the l.e.d.s are assembled and interwired on the "flat" cone leaving sufficient slack, as shown in Fig. 2. The external surface of the cone should of course be decorated as required before wiring up. Use lightweight stranded p.v.c. covered wire. The l.e.d.s could be glued in place but this was not found necessary on the prototype where the mounting holes were made to be a tight fit.

A lip is formed near the base of the cone to seat the component board. Two strips of the same paper shaped as shown in Fig. 2 were used for this and were found to be adequate.

When completely interwired, there will be four leads remaining to be connected to the board.

Roll and glue the cone along its joining flap and when set, connect the flying leads to the board.

The two wires passing through enlarged holes in the board to the battery connection should be connected next. They should be fed from below and threaded through the hollow "tree trunk" as shown in Fig. 3.

The tub used in the model shown was from the top from an aerosol can, large enough to accommodate a PP3 battery. Higher capacity batteries may be used, e.g. PP9, PP6 but would demand a much larger tub. Alternatively leads could run to a separate battery housing or a battery eliminator could be employed. This would require a suitable socket fitted to the tub in place of the battery clip.

IN USE

Connect the battery of your choice and switch on. The four groups of l.e.d.s should switch on progressively one group after the other until all thirteen are lit. They will all then go off for about 10 seconds and repeat.

If all is well, the circuit board can be glued in place at the base of the cone, fitting up against the lip on the inside. This will ensure that the circuit board is perpendicular to the axis of the cone.

Should the constructor require a short "off" time and a long "on" time, then the battery consumption would probably be unacceptably high, in which case the unit should be powered by a 9V battery eliminator.

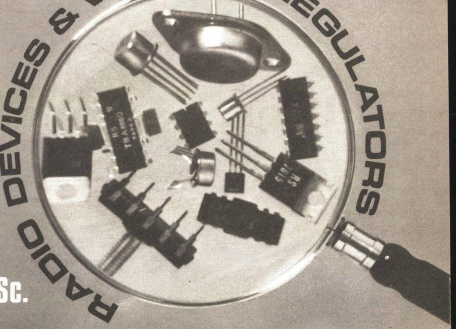
There are many other possibilities of designs. The display and electronics could possibly be fitted into a commercially produced decoration, or a hanging decoration could be made with a three-dimensional array of the l.e.d.s.

Best effect will be obtained when the decoration is sited in shadow. ⌑

I.C.s EXPLAINED

PART 3

RADIO DEVICES & VOLTAGE REGULATORS



by J.B.DANCE M.Sc.

THE integrated circuits used in the signal frequency and in the intermediate frequency stages of radio receivers must be able to operate at much higher frequencies than the operational amplifiers and audio devices we have already discussed. However, many suitable devices are available from most of the large semiconductor device manufacturers.

A.M. RECEIVERS

Most a.m. receiver devices have been designed for use in superheterodyne receivers, but we will first discuss a unique Ferranti device, the ZN414, which can be used in very simple a.m. receivers for local station listening. This device is especially suitable for the beginner; circuits using it have the advantage that no preliminary adjustments are required. The device has been designed for use in the frequency range 150kHz to 3MHz—which includes the whole of the medium and long wavebands, but the gain is quite low in the short wavebands.

SIMPLE CIRCUIT

A very simple circuit using the ZN414 device to drive an earphone is shown in Fig. 3.1. The audio output from pin 1 of the ZN414 can supply only a very small current and therefore the earphone used should have an impedance of not less than 250 ohms or the volume may be inadequate. The inductor *L1* is wound on a ferrite rod aerial for long or medium wave reception. A biasing current passes through R1 and *L1* to pin 2 of the ZN414.

PRECAUTIONS

The current required by the ZN414 is only about 0·5mA, but the amplification of the circuit is strongly dependent on the power supply voltage. As the ZN414 provides a gain of about 4,000 times (72dB), it is important that the leads to it should be kept as short as possible and that the output decoupling capacitor, C3, should be soldered close to the device. The earthed side of the tuning capacitor (the moving vanes) should be connected to the junction of R1 and C1. Failure to observe these precautions in any ZN414 circuit may result in instability.

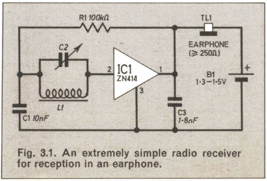


Fig. 3.1. An extremely simple radio receiver for reception in an earphone.

ZN414 WITH SPEAKER

A more complex ZN414 circuit incorporating an LM386 audo amplifier to drive a loudspeaker is shown in Fig. 3.2. The basic ZN414 circuit is similar to the Fig. 3.1 circuit, but D1, D2 and R3 form a simple voltage stabiliser which maintains the voltage to the ZN414 at about 1·3 to 1·4V. Other audio amplifiers using either an integrated circuit or discrete transistors can be employed instead of the LM386 circuit shown, but the LM386 offers one of the simplest possible circuits.

FERRITE AERIAL

An aerial suitable for the ZN414 circuits is shown in Fig 3.3. Either the medium or long wave coil is used, while the coils may be switched if a two band radio receiver is required. The coils may be fixed with polystyrene cement The tuning capacitor should have a value of 150 to 250pF.

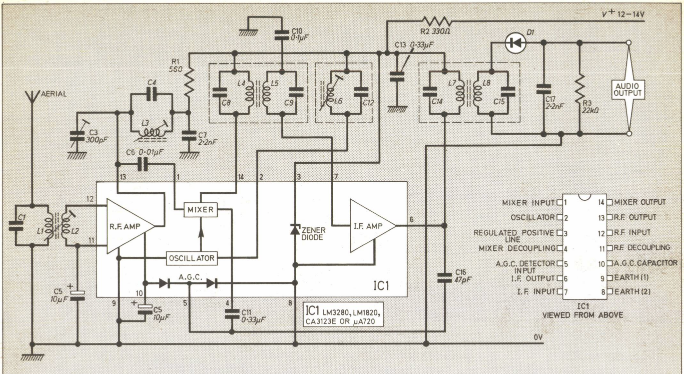


Fig. 3.4. A circuit using the LM3280, LM1820, µA720 or CA3123E devices for a superheterodyne receiver.

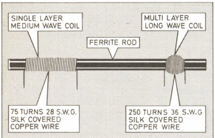

SINGLE LAYER MEDIUM WAVE COIL
MULTI LAYER LONG WAVE COIL
FERRITE ROD
75 TURNS 28 S.W.G. SILK COVERED COPPER WIRE
250 TURNS 36 S.W.G SILK COVERED COPPER WIRE

Fig. 3.3. A ZN414 ferrite rod aerial suitable for m.w. and l.w. reception.

A.M. SUPERHETERODYNE DEVICES

Integrated circuits designed for use in superheterodyne a.m. receivers are necessarily much more complex than the ZN414, but the high gain and selectivity of the intermediate stages of a superheterodyne receiver enables weak short wave stations to be heard. One well-known a.m. device for superheterodyne receivers is the SGS-ATES TBA651.

Another type of device is available from various manufacturers as the RCA CA3123E, the Fairchild µA720 and the National Semiconductor LM1820; the last device has now been replaced by an improved LM3280 device. All of these have provision for a signal frequency stage before the mixer, but other devices such as the RCA CA3088 and the Siemens TCA440 are for use in circuits where the mixer is the first stage.

A typical circuit for the LM3280, LM1820, CA3123E or the µA720 is shown in Fig. 3.4. The signal from the aerial is fed in pin 12; after amplification in the radio frequency stage it appears at pin 13. The circuit incorporating *L3* is tuned to the incoming signal frequency which is then passed to pin 1 and hence to the mixer. It is now mixed with an oscillator signal of a frequency determined by the resonant frequency of the *L6* circuit so that the frequency appearing at pin 14 (the mixer output) is the difference between the signal and oscillator frequencies. This difference or intermediate frequency has a constant value unaffected by tuning and is fed to the *L4* tuned circuit.

The intermediate frequency is coupled into the *L5* circuit and is fed via pin 7 to the intermediate frequency amplifier of the device. This provides an output at pin 6 to the output tuned circuit. After demodulation by the diode *D1*, the audio output is obtained.

The output signal from pin 6 is also coupled via pin 5 to the internal

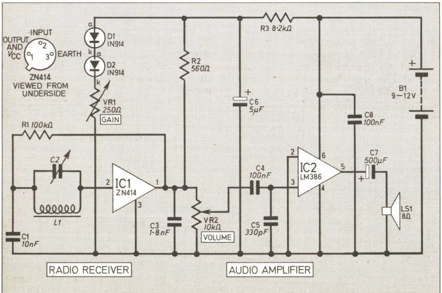


Fig. 3.2. A ZN414 circuit including a power amplifier for driving a loudspeaker.

automatic gain control circuitry which keeps the output level at pin 6 fairly constant by increasing the amplification of weak signals; it thus reduces the effect of fading.

F.M. DEVICES

Incoming f.m. signals have a frequency of the order of 100MHz and few integrated circuits (such as the SD6000 and the TDA1062) have been made available for use at this incoming frequency. Inexperienced constructors are well advised to purchase a complete front-end, since an extra centimetre or two of wire at such frequencies can greatly affect the performance.

A front-end will provide a 10·7MHz output and it is easy for constructors to make an integrated circuit intermediate frequency unit to accept the 10·7MHz signal. Quite a number of devices are available for use at the 10·7MHz frequency. For example, the Fairchild μA753 is a good 10·7MHz amplifier and its impedance is matched to the 330 ohm ceramic filters for this frequency.

One of the most widely used demodulator devices is the CA3089 type, but this has to some extent been replaced by an improved version, the CA3189.

A high performance CA3189E circuit is shown in Fig. 3.5. The incoming signal is amplified by TR1 and TR2 and the four ceramic CSFE filters provide the selectivity. The signal then passes to the CA3189 where it is amplified and demodulated.

The device incorporates many features, including provision for an S-meter (signal strength meter) automatic frequency control output, automatic gain control output with the threshold at which the gain control becomes effective being controllable by a variable resistor, and signal muting to silence the receiver as one tunes between stations.

This type of circuit is suitable for high performance receivers in which the use of such an integrated circuit enables a much simpler external circuit to be made than would be possible with single transistors.

Unlike the 3189, the 3089 devices do not have a variable threshold for the a.g.c. and the bandwidth of the 3089 devices (25MHz) is greater than that of the 3189 (15MHz), so the 3089 is more prone to instability if the component layout is poor.

The 3189 also has a better muting circuit which operates when the receiver is tuned into one of the sidebands of a signal. The 3189 also employs lower noise internal Zener diodes, but otherwise is basically similar to the 3089. The SGS-ATES TDA1200 device is very similar to the 3089 products.

All of these devices provide an output with a total harmonic distortion of about 0·5 per cent when used in the circuit of Fig. 3.5, but the distortion can be reduced to around 0·1 per cent if a twin-tuned circuit is employed between pins 9 and 10. However, an oscilloscope and wobbulator circuit is required to align the twin tuned circuit for minimum distortion.

STEREO DECODERS

The use of modern phase-locked-loop stereo decoders has greatly simplified the construction and adjust-

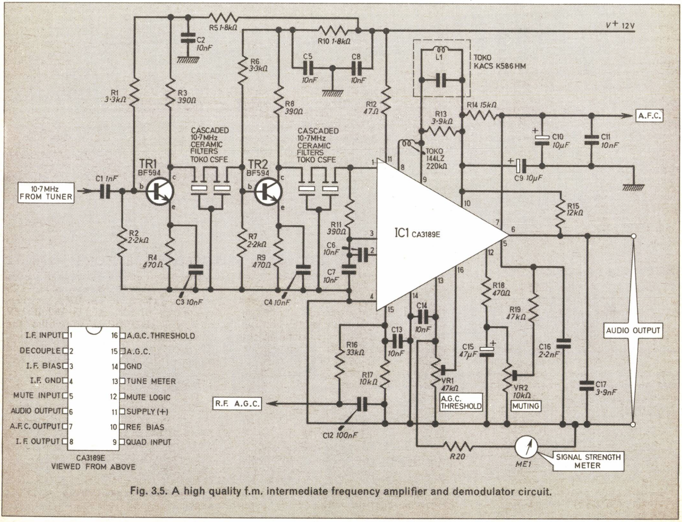


Fig. 3.5. A high quality f.m. intermediate frequency amplifier and demodulator circuit.

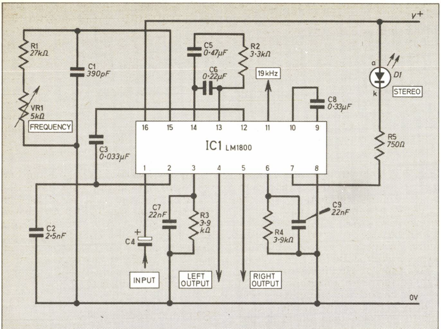


Fig. 3.6. An LM1800 phase locked loop stereo decoder.

ment of this type of circuit. The MC1310 was the first device of this type, but improved versions (such as the LM1310E) have emitter follower outputs which provide low output impedance audio signals.

A circuit using the LM1800 device is shown in Fig. 3.6; this device incorporates a hum rejection circuit in addition to emitter follower outputs, but otherwise is like the 1310 types.

The f.m. signal after demodulation is fed into pin 1 of the LM1800. The resistor-capacitor networks in the pin 3 and pin 6 circuits provide the de-emphasis characteristic and the separate audio outputs are obtained from pins 4 and 5; these outputs are each fed to the appropriate amplifier of the stereo system.

STEREO RECEPTION

When a 19kHz pilot tone is present in the stereo signal, this tone causes the circuit to be switched to the stereo mode whereupon the light emitting diode *D1* is illuminated as a stereo indicator. If the signal becomes weak so that satisfactory stereo reception is impossible, the circuit automatically switches back to the monaural mode and *D1* is extinguished. This improves the signal-to-noise ratio by some 20dB and will often provide a satisfactory monaural signal.

Other stereo decoder devices are available, such as the RCA CA3090AQ which requires an inductor, but operates on the same general principles as the circuit of Fig. 3.6. Very recently an LM1870 device has been released by National Semiconductor which uses the meter drive output from a 3089 or 3189 device (pin 13) to reduce noise at the expense of the stereo separation during weak signal conditions.

VOLTAGE REGULATORS

Integrated circuit voltage regulators are very widely used in many types of electronic equipment, partly because they often offer the ultimate in simplicity. In addition to providing a highly stable voltage output, regulator devices provide an excellent and simple way of reducing mains hum to a very low level. For example, some form of regulator circuit is required in the varicap tuning supply of f.m. and television receivers tuned in this way. In addition, TTL equipment requires 5V regulator circuits.

Regulator devices are readily available which provide maximum output currents of 100mA, 500mA and 1A at any of the following fixed voltages: 5V, 6V, 8V, 8·5V, 12V, 15V, 18V and 24V. The 100mA regulators are mostly marketed in a circular metal transistor-type package (TO-39) and plastic (TO-92), but the higher current types are packed in plastic-tab or TO-3 cans for mounting on a heat sink. High currents can be obtained by using devices which provide outputs of 3A, 5A or 10A, but a low current regulator device can be used with external transistors to make a circuit able to deliver a high output current.

Monolithic regulator devices are classified into fixed and variable output types. Fixed regulator devices can be used in very simple circuits to provide the particular output voltage for which each device is designed. It is also possible to obtain other output voltages from fixed regulator devices.

Variable regulator devices provide an output voltage which can be varied by a potentiometer or which can be varied by altering the values of one or more fixed resistors. Variable regulators have the advantage that one can obtain any voltage in a wide range from a single device so that, if one has a stock of a few variable regulators, this will be as useful as a much larger stock of fixed regulator devices for various output voltages.

An additional advantage of the use of variable regulator devices is that their line and load regulation (variation of the output voltage with change in the input voltage and in the output current) is typically some ten times better than in the case of fixed regulators. In their 1980 linear data book, National Semiconductor (one of the largest regulator device manufacturers) state that they see a trend towards the wider use of variable regulators instead of fixed device types.

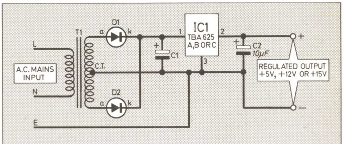


Fig. 3.7. A simple fixed voltage regulator circuit using the TBA625 series of devices.

FIXED REGULATORS

One well-known series of fixed regulator devices is the SGS-ATES TBA625 series. The TBA625A provides an output of 5V, the TBA625B 12V and the TBA625C 15V, whilst the TBA435 is a similar 8·5V device. These integrated circuits can be used in the extremely simple circuit of Fig. 3.7, C2 being necessary to ensure stability.

This simple circuit provides about 50dB of hum rejection, but the hum voltage at the output depends on the value of the input capacitor, C1. The circuit provides an output current of over 100mA, but if the output is accidentally shorted, the output current "folds back" to about 35mA. This reduces the thermal dissipation in the device.

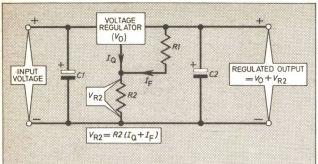

+
VOLTAGE REGULATOR (V_O)
+
R1
I_Q
INPUT VOLTAGE
+
C1
I_F
+
C2
REGULATED OUTPUT $= V_O + V_{R2}$
V_{R2}
R2
–
–
$V_{R2} = R2\,(I_Q + I_F)$

Fig. 3.8. Raising the output from a fixed regulator device.

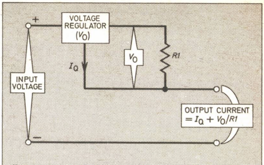


Fig. 3.9. A simple current regulator circuit using a voltage regulator device.

This type of circuit has the advantage that if a short develops in the circuits being fed from the regulator, the small current of about 35mA under short circuit conditions is most unlikely to cause any damage to the devices being supplied with power.

Similar devices are available for outputs of up to about 500mA with fold back current limiting to about 150mA. The plastic encapsulated TDA1405, TDA1412 and TDA1415 provide outputs of 5, 12 and 15V respectively and can be fixed to a heat sink by a single bolt. The quiescent current of both these types and the 100mA types is only about 10mA when no output current is taken.

THERMAL SHUTDOWN

Another series of regulator devices employs thermal shutdown circuitry instead of fold back current limiting to prevent excessive thermal dissipation from damaging the devices. The Fairchild μA78M12 and the National Semiconductor LM78L12 are similar 12V devices which can supply an output of over 100mA and which incorporate thermal shutdown circuitry. A range of devices for other voltages is available. Further protection is incorporated in high current devices to limit output current to a safe value.

Plastic packaged devices with thermal shutdown circuitry include the LM342 series for currents up to 200mA, the 78M and LM341 series for 500mA outputs and the 78 and LM340T series for 1A outputs. All are available in a wide range of output voltages.

INCREASING VOLTAGE

The type of circuit shown in Fig. 3.8 can be used with a fixed voltage regulator to provide an output voltage higher than that for which the device is designed. The increase in the output voltage is equal to the voltage across the resistor *R2*. This extra voltage is equal to the value of *R2* multiplied by the sum of the quiescent current I_Q and the current passing through *R1*. If only a small extra output voltage is needed, *R1* can be omitted. It is also possible to replace *R2* with a Zener diode and to omit *R1*.

As a typical example, if *R1* has a value of 430 ohm and *R2* is a 250 ohm variable resistor, the output from a TBA625A regulator device can be set to any value between 5V and 9V. Similarly when $R1 = 1$ kilohm, $R2 =$ 150 ohms and the regulator is a TBA625B, outputs of between 12V and 15V can be obtained. However, the variation in the output voltage is generally much smaller with such a circuit than if a variable regulator device is employed.

CONSTANT CURRENT

Current regulated circuits can be conveniently made using voltage regulator devices. Fig. 3.9 shows such a circuit which delivers a constant output current which is almost independent of the input voltage and (within limits) of the resistance of the circuit to which the current is fed. The constant current which flows is equal to $I_Q + V_o/R1$ where V_o is the fixed output voltage of the regulator device used.

DISSIPATION

When using regulator devices, care must be taken to ensure they do not become too hot. Even when a device has internal thermal protection circuitry, it is wise not to rely on this, since the chances of the device failing are much increased if it is allowed to become so hot that the thermal protection circuitry shuts down the output current.

The temperature of high current regulators is controlled by the use of an adequate heat sink, but circuit design can also greatly reduce the problem. If one uses an input voltage which is only a few volts above the required output voltage, the power dissipated in the regulator device will be much reduced.

The input voltage must always be somewhat greater than the required output voltage, or the device will cease to function correctly. The minimum difference between the input and output voltages for correct operation is known as the "dropout" voltage and is usually in the range 1·2V to 3V.

Next month. *In the final part of our discussion on linear devices, we will look at variable regulator devices, timers, oscillators and phase locked loops.*

I.C. LEAD-OUT IDENTIFICATION: SUPPLEMENT TO GUIDE TO POPULAR LINEAR I.C.s*

Device	*Code*	*Device*	*Code*	*Device*	*Code*	*Device*	*Code*	*Device*	*Code*
						TL074	X	MC3360	f
Op-Amps				F.e.t. Op-Amps		TL081	D	SL414A	g
301A	A, J, R	709	I, S	351	D	TL082	G	SL415A	g
308	J, R	725	K	353	G	TL084	X	TBA800	h
318	H, P, Y	741	D, M, T	355	D			TBA810	h
324	X	747	Q, U	356	M	Mono Power Amps		TBA820	i
343	M, T	748	A, J, R	357	M	LM380	a	TDA2006	j
344	J, R	1458	B, L	CA3130	F, O	LM383	b	TDA2030	j
348	X	CA3080	E, N	CA3140	F, O	LM384	a		
349	X	3401	V	CA3160	F, O	LM386	c	Stereo Power Amps	
358	B, L	3900	V	CA3240	U	LM388	d	LM377N	k
ZN459	C	4136	W	TL071	D	LM389	e	LM378N	k
NE531	A, J	TCA220	Z	TL072	G	LM390	d	LM379N	l

* *Presented free with the October 1980 issue of Everyday Electronics.*

OPERATIONAL AMPLIFIERS

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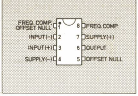

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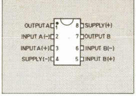

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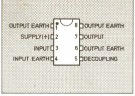

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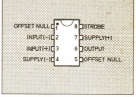

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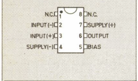

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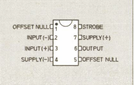

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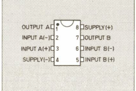

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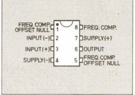

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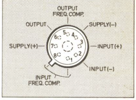

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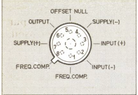

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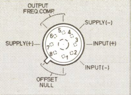

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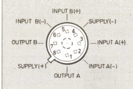

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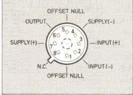

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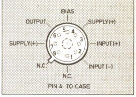

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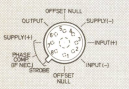

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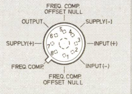

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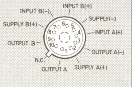

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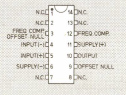

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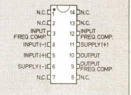

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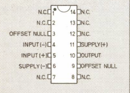

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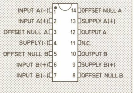

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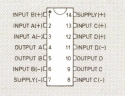

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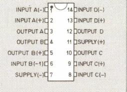

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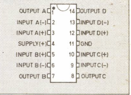

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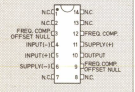

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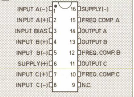

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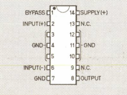

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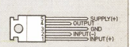

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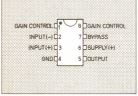

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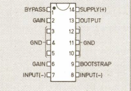

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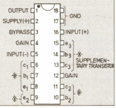

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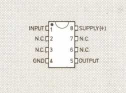

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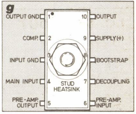

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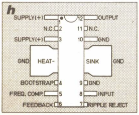

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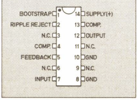

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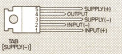

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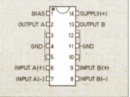

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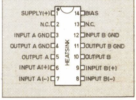
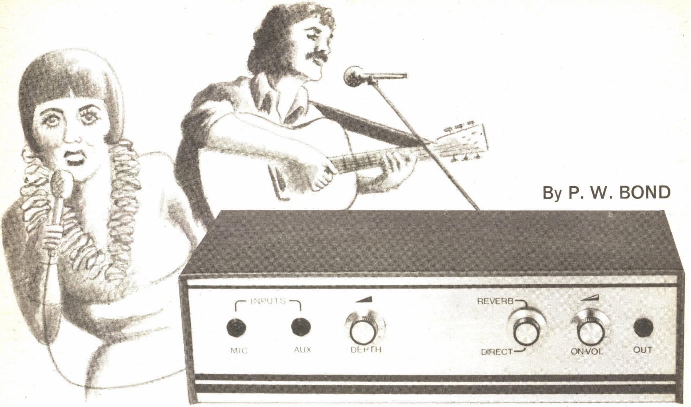




By P. W. BOND

SPRINGLINE REVERBERATION UNIT

REVERBERATION is the effect produced when sound waves are reflected from several surfaces so as to prolong the original sound. Empty rooms, halls and theatres all have a reverberation time which is related to the surface area of the reflective surfaces within them.

Artificial reverberation can be used to create an illusion of enclosed spaciousness by producing a sound which is identical to that heard in large buildings with several square metres of reflective surfaces, and indeed, a source of artificial reverberation is always a part of modern production studio equipment.

Nowadays, artificial reverberation can be produced by electronic "delay lines" and already analogue devices are available which work on the bucket brigade principle. However, tape loop and spring line reverberation systems are still common.

Although a complete reverberation unit is expensive, the heart of the unit, a spring line, can be obtained for quite modest prices and in a choice of lengths and the project described here shows you how to build a fairly versatile reverberation system based on a commercially available spring line.

SPRING LINE

The spring line, when purchased, comes complete with the transducers necessary for generating and detecting the mechanical vibrations of the spring. The drive coil converts the signals from the source into mechanical vibrations. These vibrations travel along the spring and because they are not completely absorbed at the far end, they create the effect of prolonging the signal applied.

The vibrations are converted back into electrical signals by the pick-up coil and these signals now represent the original sound with reverberation applied. They have to be mixed together with the original signal to produce the desired effect.

The circuitry is responsible for the generation and detection of the spring line signal as well as amplifying and mixing the source signals together. The user of the unit has control over the depth of reverberation and the amount of reverberation mixed with the source signal, and an output volume control is also provided to give adjustment of the level of signal being applied to the succeeding equipment.

The unit has inputs suitable for a low impedance microphone or guitar pick-up, so the unit may be used in conjunction with other stage equipment. The maximum reverberation time is dictated by the length of the spring line and clearly the longer the spring used then the longer the signal takes to decay.

CIRCUIT

The circuitry associated with the spring line is shown in Fig. 1. Low impedance microphones are connected to SK1 which links the source signals to a pre-amplifier stage centred on TR1. This common base stage has a low input impedance and amplifies the low voltage signals from the microphone before subsequent processing takes place.

The auxiliary input socket SK2 is wired so that when it is not used, signals from the microphone pre-amplifier stage are applied to IC1. However, when SK2 is used contacts are opened so as to disconnect the microphone stage and signals fed into SK2 are applied directly to amplifier IC1.

A 741 operational amplifier is used as IC1, and indeed for all of the integrated circuits in this project. This i.c.

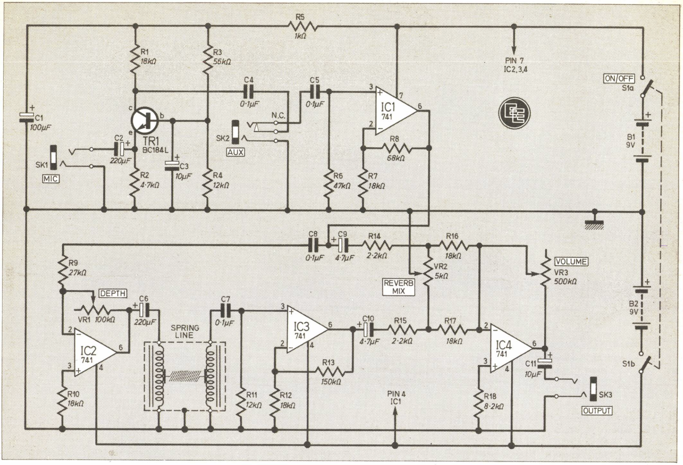


Fig. 1. Full circuit diagram of the Springline Reverberation Unit.

is connected as a non-inverting amplifier which has a gain of just under 5, the gain being determined by the values of R7 and R8.

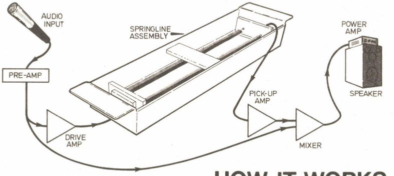
Part of the output of IC1 is fed to the final stage of the unit where it feeds a direct non-reverberation signal to the mixer amplifier. The output of IC1 also feeds IC2 which forms the spring line drive amplifier.

The second i.c., IC2, is wired in the inverting mode and the setting of VR1 (in association with R9) governs the gain of the stage, and therefore the amount of signal applied to the drive coil of the spring line. Potentiometer VR1 is designated DEPTH since as the control is advanced the more the spring line is made to vibrate and produce a greater reverberation effect.

PICK UP COIL

The spring line pick-up coil converts the vibrations from the spring into small electrical signals, and IC3, an op-amp connected in the non-inverting mode, amplifies the signals by a factor of about nine. The output of IC3 is the reverberation signal and it is mixed with the output of IC1.

The mixture of reverberation and normal direct signal which is fed to the final output is governed by the setting of VR2, designated REVERB MIX. The mixing of the two signals takes place in the final stage.



HOW IT WORKS

The audio signal is first amplified and then split into two. One path goes to the spring line unit.

Here the signal is amplified and then turned into mechanical vibrations. These are transmitted down the spring, picked up and turned back into electrical signals.

These signals are further amplified and mixed with the other part of the audio input straight from the input pre-amp.

The ratio of modified to unmodified signal determines the amount of reverberation in the final output.

The final i.c. IC4 is wired as an inverting summing amplifier the gain of which is governed by the setting of VR3 which acts as a volume control. The output of the reverberation unit is fed to SK3. Maximum output is quite large and the impedance is low, therefore the unit will be suitable for most amplifier inputs.

The low current drain enables batteries to be used and in fact two are needed to provide the positive and negative supplies for the op-amps. The ON/OFF switch is combined with VR3.

CONSTRUCTION starts here

STRIPBOARD

The stripboard layout is based on the use of small components (see Fig. 2) and radial type electrolytic capacitors are used. Radial electrolytics have their leadouts from one end of the can therefore allowing the can to stand vertically and occupy less board space.

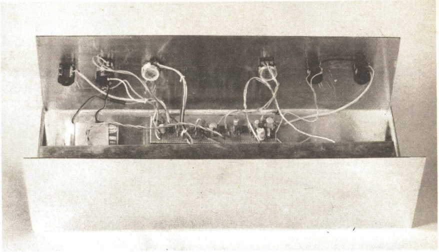
Construction should start with making the breaks in the copper strips on the reverse side of the stripboard. The components can then be located and soldered in position starting with the resistors, then the other passive components and finally the semiconductors.

Care must be taken here to make sure that the transistor and i.c.s are not overheated during soldering. The use of i.c. sockets would help here.

A full layout of components is shown in Fig. 2, with the leads to ancillary and frontpanel components alphabetically coded. Stripboard pins are used to connect these ancillary component leads to the circuit board. They are not essential but they do make the process of terminating the wires a little easier.

POLARITY

When locating the i.c.s, transistor, and capacitors pay attention to the polarity of their leads. The 741 op-amps are eight-pin dual-in-line devices (d.i.l.) and the end where pin 1 is located is indicated by a depression in the package. On some devices pin 1 is marked by means of a recessed dot. The transistor and op-amp lead-outs are given on the diagram.


Interior view of the unit from behind showing the wiring to the front panel components.

The spring line will have four terminals, two input tags and two output tags, and also a connection to the case of the spring line is available. One or both sets of tags will be marked and these should correspond to the drive and pick-up coils.

The drive coil will be labelled "input" and the pick-up coil will be marked as "output". When the spring line is mounted in the case, it is important to check to see that the spring does not touch any object or surface and that it is free to move.

CASE

A large case was used for the prototype reverberation unit since a long spring line was used. The case used in the prototype was a metal one (Norman Rose type TP7), but if preferred a wooden one could be used with a piece of aluminium for the front panel. In any event the case chosen should be large enough to accommodate the spring line used.

COMPONENTS

COMPONENTS approximate cost £16·50 excluding case

See Shop Talk page 792

Resistors

R1	18kΩ	R10	18kΩ
R2	4·7kΩ	R11	12kΩ
R3	56kΩ	R12	18kΩ
R4	12kΩ	R13	150kΩ
R5	1kΩ	R14	2·2kΩ
R6	47kΩ	R15	2·2kΩ
R7	18kΩ	R16	18kΩ
R8	68kΩ	R17	18kΩ
R9	27kΩ	R18	8·2kΩ

All ¼W carbon ± 5%

Potentiometers

VR1	100kΩ log. carbon
VR2	5kΩ lin. carbon
VR3/S1	500kΩ log. carbon with ganged d.p.s.t. switch

Capacitors

C1	100μF 12V elect. radial	C7	0·1μF polyester
C2	220μF 12V elect. radial	C8	0·1μF polyester
C3	10μF 12V elect. radial	C9	4·7μF 12V elect. radial
C4	0·1μF polyester	C10	4·7μF 12V elect. radial
C5	0·1μF polyester	C11	10μF 12V elect. axial
C6	4·7μF 12V elect. radial		

Semiconductors

IC1-IC4	741 op-amp 8 pin d.i.l. (4 off)
TR1	BC184L *npn* silicon

Miscellaneous

SK1-SK3 0·25 inch mono jack sockets with single break contacts. (3 off)
B1, 2 9V battery, type PP3 (2 off).
Spring line 355mm long, Maplin type XB84F or similar; stripboard, 0·1 inch matrix, 58 holes by 16 strips; case, 440 × 205 × 125mm, metal or wood to suit (Norman Rose type TP7 or similar); battery connectors (2 off); control knobs (3 off); interconnecting wire; mounting hardware for circuit board and spring-line; aluminium strip for battery clip.

SPRINGLINE REVERBERATION UNIT

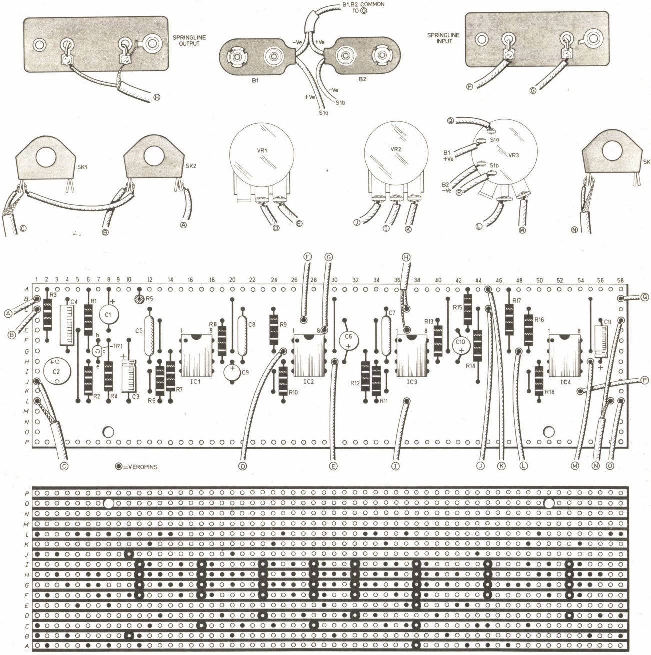
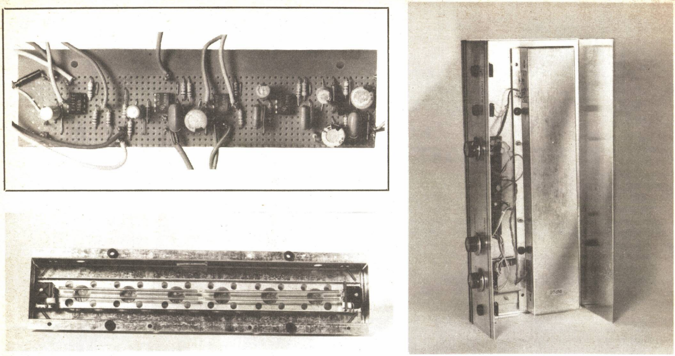


Fig. 2. Full board layout and interwiring details. No case is shown as this is determined by the length of the spring line used therefore the controls need not necessarily be positioned as shown. The batteries are held in place by a piece of aluminium bent into an S-shaped bracket. This is also not shown.



Top left shows a close up view of the circuit board. Bottom left shows the inside view of the spring line unit. The spring line drive and pick-up transducers can be clearly seen. Photograph to the right shows the interior of the unit from the front showing the spring line mounted in position and associated wiring.

The circuit board is mounted using stand-offs or paxolin spacers and it is best to terminate the wires to the board before it is finally secured.

The batteries, two PP3's, were secured using a small piece of aluminium strip which was fashioned to clamp the batteries. This clamp was bolted to the case so that the batteries were not able to move. Other methods could be used but if the unit is going to receive some rough handling then the aluminium clamp is recommended.

The control knobs are fixed to the spindles of the potentiometers and a location for the panel lettering can then be chosen. Letraset transfers were used on the prototype with some strips of glossed paper to indicate the function of the unit. The transfers should be sprayed with suitable fixative for protection.

ATTENUATOR

The output of the reverberation unit is variable to a maximum level of approximately two volts. Since the output impedance is low this output will be suitable for a tape recorder, mixer or a main amplifier. Connect medium impedance microphones and guitar pick-ups to SK2 and low impedance microphones to SK1.

These inputs are quite sensitive because of the low level outputs available from microphones and guitars, therefore, it is not possible to connect the output of a tape recorder or mixer to the reverberation unit without first attenuating the signal. An attenuator for use with such equipment is shown in Fig. 3 and this will reduce a signal of 500mV to a level suitable for application to the AUX input of the reverberation unit.

Two resistors are required for a mono source and three for a stereo source. The output of the reverberation unit is mono only. The components required for the attenuator are shown at the foot of the diagram. This does not include the plug for the tape recorder or mixer or whatever. A suitable plug will have to be obtained to connect to this equipment.

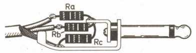


Fig. 3. The construction of a suitable attentuator lead. Ra and Rb are 560kΩ resistors and Rc is 10kΩ in value. All are ¼W carbon types. Ra is omitted if the input to be attenuated is monaural.

OPERATION

The operation of the unit will become apparent when used. The DEPTH control determines how much reverberation is produced by the spring. As the control is advanced the spring vibrates more. If the control is advanced too far, and high level signals are being fed into the unit, there is the possibility of distortion appearing at the pick-up coil of the spring line, which is detected by the ear as a "twang".

The REVERB MIX control determines the ratio of the reverberation signal to direct source signal. When the control is midway along its travel the output is made to comprise of half reverberation output to half input signal.

The actual amount of reverberation is dependent on the setting of the DEPTH control. If the REVERB MIX control is turned fully anti-clockwise then only direct input signal appears in the output, that is, the input without reverberation.

On the other hand, if the mix control is advanced fully clockwise the output signal from the reverberation spring line is fed to the output, this gives a rather "ghostly" version of the input signal.

The volume control is also used to switch on the unit via its ganged switch and also controls the signal which appears at the output. The battery drain is quite small and should give a few hours continuous use. When the reverberation unit is in use it should not be placed on any surface which vibrates as these vibrations will reach the spring and be reproduced in the output. ⌑

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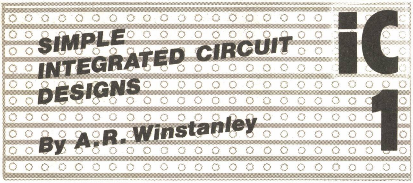


SIMPLE INTEGRATED CIRCUIT DESIGNS

iC 1

By A.R. Winstanley

NO ENTRY INDICATOR

This project was designed initially for photographers carrying out their own developing in a domestic darkroom. The unit comprises a small case which is placed outside the door of the darkroom; on the case is a small indicator lamp designated NO ENTRY and, by operating a switch within the darkroom, the indicator can be made to flash on and off.

This forms a courteous reminder that developing is in progress and so the darkroom should not be entered. This is a more professional means of keeping people out than nailing a sign to the door or locking it altogether!

Other applications however soon came to mind. By suitably re-lettering the lamp, the device could be used for other purposes. For example, in offices: "Interview in Progress" or "Engaged". Anyone who regularly uses a tape recorder may find this design useful if the indicator is designated "Recording in Progress" or similar. In fact, the device forms a very simple general purpose signalling system.

Batteries have been chosen to power the project. This reduces the complexity and cost of construction.

CIRCUIT DESCRIPTION

As with all designs in this series, a single integrated circuit is used, see Fig. 1. The heart of the unit is IC1, a 555 timer chip. It can be made to perform several functions, including, in its astable mode, turning a load (for example, an indicator lamp) on and off continuously.

When wired as an astable multivibrator (a circuit having no stable state and so oscillating freely), a stream of pulses is produced at pin 3, the output pin. The frequency, or number of pulses per second, of the output waveform is controlled by three external components, R3, R4 and C2.

Upon initial application of power, C2 will start to charge up through R3 and R4 until the voltage at pin 6 (the "threshold pin") equals two-thirds of the supply voltage. At this point, the i.c. will switch over internally and force the capacitor to discharge through R4 into the "discharge" terminal, pin 7. When the voltage on this pin has dropped to one third supply, C2 will then charge up again, and then the process repeats itself.

The relatively slow charging and discharging action of the capacitor is transformed by the i.c. into a very sharp on-off action at the output, where a stream of square waves is produced. The square wave when "high" is almost at 9V and when "low" about 0V.

FREQUENCY

By adjusting R3, R4 and/or C2, the frequency of operation can be altered. Here values have been chosen which give an "on" time of about 0·5 seconds and an "off" time of roughly 0·2 seconds, implying a frequency of approximately 1·4Hz. However, the timing components do have manufacturing tolerances, and so this frequency may not be exact. In particular the tolerance on C2 is quite large.

Connected across the output are two light-emitting diodes, D1 and D2, each with a current-limiting resistor. When the output is high, the l.e.d.s are illuminated, and so the indicators flash on and off. Small l.e.d.s were chosen rather than ordinary light bulbs in order to improve current consumption.

One of the indicators is mounted externally in a separate case and forms the actual NO ENTRY indicator, whilst the other l.e.d. is just a repeater lamp which reminds the user that the unit is in operation.

POWER SUPPLY

A 9V rail is derived from a series of dry batteries. In fact six 1·5V HP7 cells are wired in series to provide the necessary power supply. This ensures that the device does not flatten the batteries if used regularly. Occasional use only of the Indicator means that a PP3 battery may be employed instead, however.

Capacitor C3 decouples the power supply. As the batteries start to age they will become less able to supply current peaks demanded when the l.e.d.s illuminate. The result is that the supply rail voltage drops as the current drawn increases; this produces ripple.

C3 acts as a reservoir which provides the extra current required to maintain stable operation of the flasher. The Indicator is switched on and off at S1.

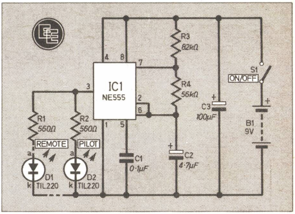


Fig. 1. Complete circuit diagram of the No Entry Indicator.

STRIPBOARD

The circuit can be assembled on a piece of 0·1 inch stripboard measuring 10 strips × 24 holes, see Fig. 2.

Take the stripboard and drill two 6BA clearance holes in the positions shown. Then make all the breaks (ten in all) in the copper strips using a twist drill or a spot face cutting tool.

An 8-pin d.i.l. socket should be used for IC1, and this should be soldered into place first of all. Continue by soldering in the solid jumper wires.

There are five of various lengths and they can be made from 22 s.w.g. tinned copper wire.

Follow on with the miniature resistors and finally the capacitors. The electrolytic capacitors are polarised and must be orientated correctly. Fit IC1 the right way round into the d.i.l. socket: a notch or dot identifies pin 1 of the i.c.

CASE

The circuit board is encased in a plastic box of dimensions 120×80×35mm. On this box are mounted S1, and also one of the l.e.d.s. The circuit board is bolted on one side of the box using 6BA spacers and hardware.

There is just enough room in the case to accommodate the 9V (6×HP7) battery holder, although if a lower-capacity PP3 battery is used then there is ample room inside for this. Note that a PP6 battery will *not* fit within the specified box.

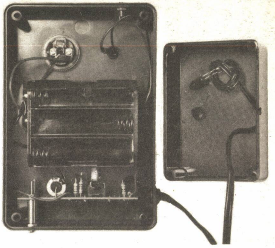
A small matching box is used to mount the other light-emitting diode. This box measures 71×49×24mm, and is connected to the main unit with twin-core flex of suitable length.

FINISHING OFF

The larger case can be lettered as necessary, with the smaller case being labelled NO ENTRY or whatever is required. Lettering can be applied with rub-down dry transfers, and can then be protected with a few coats of aerosol lacquer.

The necessary interwiring is also given in Fig. 2; general - purpose stranded insulated wire can be used. The only point to watch is that the l.e.d. indicators are wired the right way round, and if there is a chance of the l.e.d. connections shorting together, 2mm p.v.c. sleeving can be employed to eliminate this possibility.

No setting up is required, so once construction is complete, snap on the battery holder and switch on. Both l.e.d.s should be flashing regularly. If this is so the unit is finished and ready for use.



Interior view of both boxes showing the main unit on the left and the smaller box housing D1 on the right.

INSTALLATION

The smaller case is positioned at the door (or where required), preferably where sunlight will not fall onto the l.e.d. Bright light like this may cancel the flashing effect of the indicator.

The main unit can be located in any convenient position in the darkroom. Bear in mind the eventual need to replace the batteries, so do not fix the main unit permanently to the wall, but preferably leave it on a table top or in a similar place. ⌑

COMPONENTS

Resistors
R1,2 560Ω (2 off)
R3 82kΩ
R4 56kΩ
All ¼W 5% carbon

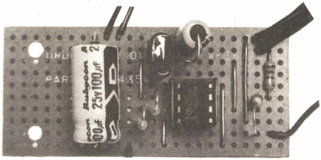
See **Shop Talk** page 792

Capacitors
C1 0·1µF mylar
C2 4·7µF 63V elect.
C3 100µF 10V elect.

Semiconductors
IC1 NE555V timer i.c., 8-pin d.i.l.
D1,2 TIL220 0·2 inch red l.e.d. (2 off)

Miscellaneous
S1 Single pole switch, Hekla rocker type or similar.
Verobox 75-2860J, 120 × 80 × 35mm; Verobox 75-1413E, 71 × 49 × 24mm, or similar; stripboard 10 strips × 24 holes 0·1 inch matrix; 8-pin d.i.l. socket for IC1; battery clip; 9V HP7 battery holder (see text); clips for D1 & D2 (2 off); twin-core flex to suit.

Guidance only Approx. cost **£6 complete**



Above left. Close-up view of the top-side of the circuit board.

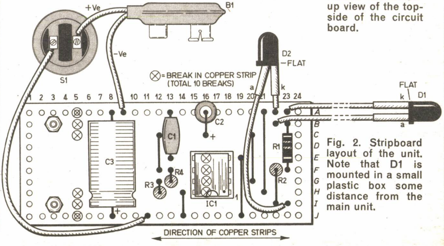


Fig. 2. Stripboard layout of the unit. Note that D1 is mounted in a small plastic box some distance from the main unit.

SQUARE one FOR BEGINNERS

Last month we dealt with the art of good soldering. This month we should like to pass on some guide lines on the subject of connecting wires.

WIRES

Connecting wires can be divided into roughly four categories: single-strand bare; single-strand insulated; multi-strand insulated; and plastics covered screened containing one or more insulated strands.

Single strand wire is sized according to the standard wire gauge, s.w.g. (for example, 22 s.w.g.). Multistrand is sized according to the number of strands and the diameter of each strand (for example, 7/0·2mm).

Screened cable is used where it is necessary to "shield" one or more insulated strands from possible radiation or interference sources. The "shield" takes the form of a woven wire mesh which surrounds the insulated strands to be screened.

LINK WIRES

Link wires are used on circuit boards where it is not easy to connect one component to another or to connect one section of copper strip to another located some distance away. Also, link wires are used extensively to interwire the pins of integrated circuits.

For link wires on circuit boards use a fairly stiff tinned copper wire. This is bare, single-stranded, copper wire with, in most cases, a special "fluxed" coating for easy soldering and does not oxidise easily. It is always a good idea to rub or scrape the tip of the wire *very* lightly with an abrasive, such as emery cloth, prior to inserting on the board and soldering. The bending of the link wires is best accomplished with a pair of long-nosed pliers.

Available in a vast range of standard wire gauges (s.w.g.), the wire was until recently only sold by weight and came on reels. Now some advertisers, apart from selling reels, offer kits of wires in various lengths and gauges. However, if you can afford the initial outlay, we have found that the purchase of reels would appear to be a better buy.

For the majority of EE projects 22 s.w.g. wire is most suitable.

SLEEVING

If there is any possibility of link wires contacting with other wires or components and forming a "direct short circuit" then insulating plastics sleeving should be used. This is a thin tube of plastics material which can be cut to the required length and slipped over the wire to provide an electrical isolation from other components and wires.

Sleeving comes in a variety of colours and is often used to form a colour coding system to help in any future fault tracing problems. A typical arrangement would be: brown or red for positive supply leads; blue, black or green for negative or zero "earth" volt lines; and yellow for short signal leads.

Sleeving is also useful for protecting exposed tags on controls and switches or where two wires are joined together. A separate larger diameter piece of sleeving is cut and slipped over the connecting lead and when the lead is soldered in position the sleeving is simply pushed over the solder joint or over the soldered tag so protecting it from any possible short circuits.

ENAMELLED WIRE

Enamelled wire is single-strand solid copper wire with a thin coating of red or brown coloured enamel for insulation purposes. This is sometimes used for "linking" purposes, particularly for the dense area, but is usually used for winding coils and transformers.

The enamel must be scraped away with a knife or piece of emery paper so that the copper is exposed at the end of the wire. Only the minimum length required to make the soldered joint should be exposed.

INTERWIRING LEADS

The constructor has a choice from two types of interwiring leads for use from circuit boards to remote mounted components. These are coloured insulated single strand solid wire and coloured insulated multistrand wire.

Where there is the likelihood of vibration or the continuous removal of the board, as in experimental layouts, from its case multistrand wire is the best choice for interwiring components. This is because multistrand wire stands up to regular bending much better than solid wire. It is more flexible.

The only drawback with multistrand is that, being very flexible, it has a tendency to droop onto other components and unless tied or fixed becomes very untidy and makes it difficult to trace particular wires.

Multistrand wire is specified by number of strands and each individual strand diameter. The most popular range for EE projects is 7/0·2mm (7 strands each 0·2mm diameter).

The solid single strand wire is much easier to route around component layouts and, once bent, will usually stay in position. The use of solid wires should be avoided where there is the possibility of vibration or regular bending of wires as they are prone to snap off under stress.

RIBBON CABLE

A wire which is coming more and more into amateur use is the "ribbon" or "rainbow" cable. This is formed by a number of different coloured plastic insulated wires bonded together to give a flat ribbon or tape appearance.

Available in single strand or multistrand, this wire is ideal for microprocessor based projects and where a light emitting diode display matrix is used.

The cable usually comes in 10 or 20-way lengths to suit or can be split to any combinations of wires.

MAINS LEADS

Mains cable from equipment is always of the insulated multistrand type and colour coded: brown for live (L) or positive; blue for neutral (N); green and yellow striped for earth (E). The live lead to equipment, usually to a mains transformer, should always be fused via a panel mounted or chassis mounted fuseholder. The rating for the fuse is given in the components list.

Never pass a mains lead through a bare lead-in hole in the side of the case, the results can be disastrous and highly dangerous.

Never, absolutely never, tie a knot in mains cable to act as a strain relief against the inside of the lead-in hole.

The **only** correct way is to always fit a rubber grommet where the cable enters the case and use a cable/strain relief clamp. Also available on the market is a combined bush which acts as a grommet and clamp.

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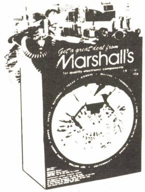

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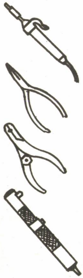

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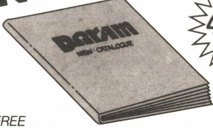

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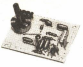

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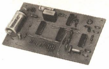

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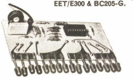

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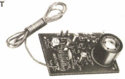

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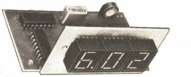

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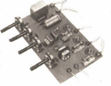

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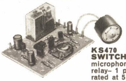

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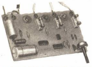

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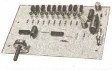

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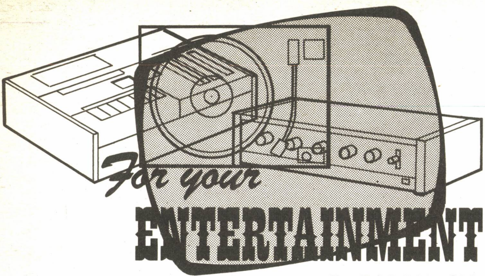


By BARRY FOX

Stereo Television

There has been much talk lately of stereo sound with television. This is because several Japanese TV stations are now transmitting two channels of sound along with their pictures.

Sometimes the two channels are left and right for stereo music but frequently they are in different languages. In this way a film can be transmitted with the option of a native language soundtrack or a dubbed language soundtrack. Students in Japan use these bilingual telecasts to help them learn foreign languages, expecially English-American.

The electronics firms are also very enthusiastic about stereo television because it has given them the chance to sell a whole new generation of receivers!

Several European countries are also thinking of starting a stereo TV service. Sweden and Germany are for instance well on the road to a full commercial service. Almost certainly, however, Europe will use a different system from Japan.

The Japanese have backed the so-called f.m.–f.m. system and this puts the second channel of sound on a sub-carrier which is transmitted piggy-back on the normal sound channel. In other words it's similar to the multiplex system used all over the world to transmit stereo sound on v.h.f. f.m. radio. In Europe, however, the stereo televison system is more likely to rely on two completely separate sound carriers, each transmitted on a slightly different frequency.

Simulcast

In Britain there is unlikely to be any stereo sound, of either system, for many years yet. The BBC is standardised on a clever digital system called "sound-in-syncs" for the distribution of TV picture and sound signals between transmitters and studios across the country.

According to this system the TV sound is converted into digital code and packed into the video signal waveform, using the gaps left by the synchronisation pulses. So only a video signal need be distributed. At the other end of the distribution link the digital signals are, of course, "unpacked" from the video signal and converted back into conventional analogue sound for normal transmission and reception.

Unfortunately, there is only enough room in the video waveform for a mono sound signal. So, obviously, a move to stereo would mean a drastic and expensive re-think by the BBC. And the last thing the BBC can afford at the moment is a drastic and expensive re-think on anything other than absolute essentials. So, for the foreseeable future at least, we shall have to make do with "simulcasts".

A simulcast is a simultaneous broadcast from both TV and radio stations. The television station transmits the colour TV programmes with ordinary mono, single channel sound, and arranges with a friendly radio station to transmit the same sound on f.m. radio in stereo.

The BBC quite frequently offers simulcasts because there is obviously much less of a bureaucratic hassle in linking BBC TV with BBC radio than there is in linking a local commercial radio station with a local commercial TV station. Apart from anything else both the radio and TV commercial stations have to carry the same adverts if they are to run a simulcast. Also it often happens that a local commercial radio station and local commercial TV station cover different areas of listeners. For instance, many people in London who can receive Thames and London Weekend TV will not be able to receive Capital Radio in stereo.

Headphone Viewing

The ideal way to watch a simulcast is to place the TV set halfway between a stereo pair of loudspeakers hooked up to a stereo radio. But this can be terribly inconvenient and quite often the small picture looks wrong when stranded between a widely spread pair of large loudspeakers.

This is where a pair of good stereo headphones comes into their own. You plug the headphones into the output of your stereo radio receiver and wear them to hear the stereo sound while watching the TV screen.

There is, by the way, an interesting compromise between headphone listening and loudspeaker listening—a chair with loudspeakers built in. The DIY enthusiasts might like to look at the idea. It isn't even a new proposal.

Way back in the twenties there were plans to install cinema seats with a pair of loudspeakers, one on each side of the cinema goer's ears. The pictures on screen would then seem to be accompanied by a binaural surround of sound. Basically, all you do is clamp a pair of good loudspeakers one on either side of an arm-chair so that the sound from the left loudspeaker goes into your left ear and the sound from the right-hand loudspeaker goes into your right ear. In practice it's not quite as easy as that. There are acoustic problems and it isn't all plain sailing to produce a chair that is both comfortable to sit in and will reproduce hi fi sound in glorified headphone fashion.

A couple of years ago a British firm (Sound Seating Systems of Carshalton, Surrey) made a very creditable stab at the problem with the "Nova" chair. The main disadvantage of this chair was its high price. It cost, £1,000 plus so was out of the price range of most people. But a few well-heeled pop stars are now relaxing in Nova chairs.

Memory Games

During the summer the *Sunday Times* reported some tests carried out in the USA on training students to remember strings of random numbers. After 230 hours of training, spread over 20 months, one student found he could remember up to 79 digits. Although everyone seemed very excited over this, similar training sessions have in fact been going on in homes all round the world for the last year or so.

The Philips G7000 Videopac computer game can be used with a wide range of solid state cartridges which programme it to play a large selection of games. In fact many of the games aren't really games at all. Cartridge number 7, for instance, offers the choice of a series of mathematical challenges and a memory test called "Echo".

For this test four digits appear on the TV screen and one of them flashes briefly to the accompaniment of an identifying audio tone. The screen then says "your turn" and the operator presses the corresponding number on the keyboard. The screen then flashes two digits and the operator has to type in the same two from memory. Then three digits are flashed.

This goes on and on with the operator having to memorise an ever lengthening string of random numbers i.e. just like those USA tests. You are allowed three mistakes but after the third mistake the game is over and the machine has won.

The maximum possible score is 99 different digits committed to memory. When I borrowed the game for a while a local 16 year old had soon notched up a half century of memorized digits.

In the atmosphere of a traditional school classroom such a strenuous memory test would be something for children to fear; but package the same test as a TV game and it immediately becomes an entertaining challenge. Electronics manufacturers found out very early that it is the kiss of death to label anything an "educational aid" or "test". But call the same thing a "game" and it will sell like hot cakes.

Everyday News

LIGHT LINKS FOR TOMORROW'S PHONES

OPEN DAY AT BRITISH TELECOM RESEARCH LABORATORIES

By the end of the century homes will be "fibred" to bring a variety of additional services to the telephone subscriber.

Links between the local exchange and the subscriber's premises will be glass fibre strands instead of present day copper wire.

Along these hair thin strands of glass, speech, video and data signals will be transmitted as pulses of light.

This is suggested by British Telecom (part of the Post Office) as a logical and realistic development from the optical-fibre communication systems now entering service in various parts of the country in the trunk routes of the telephone network.

For domestic and business customers, a low cost optical f.m. system operating up to 8 or even 34M bits is now under active development. Gallium arsenide edge-emitting l.e.d.s are likely to be used as optical power transmitters, rather than more expensive laser devices. At the subscribers premises a simple receiver incorporating a PIN photodiode/f.e.t preamplifier would be used.

High Capacity Systems

Further use of optical fibres is envisaged in high-capacity systems carrying nearly 4,000 calls per fibre pair for use as communications "highways" between cities or under the sea. For this purpose a data rate of 280M bits/s is being studied, with intermediate repeaters or signal amplifiers inserted in the fibre at intervals of 30 to 50km. This represents a considerable advance on present 140M bit systems, with repeater spacings of 8km and compares very well with the 2km spacings of repeaters in conventional land coaxial cable links, and with spacings of about 5km for submarine cables.

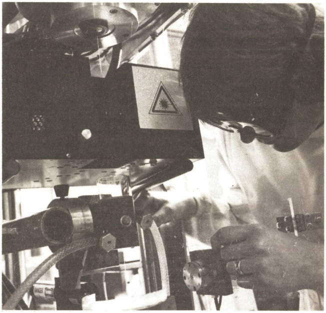
To do this monomode fibre will be needed, with a bandwidth one hundred times greater than the best multimode fibre. Also, such systems will need to operate at longer wavelengths—1·3 to 1·6 micrometres instead of 0·85 micrometres—where the loss can be as little as 0·5d B/km compared to today's 3-5dB/km. Lasers will be made from gallium indium/arsenide/phosphide, and detectors from gallium/indium/arsenide.

● *All this is the outcome of research and development at British Telecom Research Laboratories, Martlesham Heath, Suffolk. Optical-fibre communication systems are just one example of the work undertaken at this leading establishment that was revealed during open days held in September.*

More than 3,000 guests from Parliament, industry, the universities, Government Departments, learned societies and other research laboratories had the privilege of seeing "where more of tomorrow's achievements are now in the making for the benefit of telephone users at home and abroad".

Until the 1970s, the Post Office Research Station (as it was formerly) was located at Dollis Hill London. For half a century important work, including during wartime the creation of possibly the world's first electronic computer for helping the Enigma decyphering operation, was performed at Dollis Hill. This tradition is now being continued in the large modern establishment built on a disused RAF Station at Martlesham Heath. Here the central building is a seven-floor laboratory block, planned to meet the needs of new technologies such as digital switching and transmission, microelectronics and optical fibres.

Martlesham employs nearly 1,900 people of whom 850 are professional engineers or technologists, and 550 technically qualified support staff.



Checking an "optical" fibre with a laser to ensure that any surface micro cracks, due to stretching, have been coated with a silicon resin.

Fibre Causes Hustle In I.C.s

Future developments in optical-fibre systems are dependent upon faster semiconductor logic devices for signal processing. At operating speeds in excess of 100M bits silicon has its limitations and gallium arsenide (Ga As) is being investigated as an alternative. New ideas in circuit design are also being exploited. For example, Capacitive Coupled Logic (C^{2}L) using GaAs Schottky gate depletion mode MESFETS (Post Office patented).

This demonstrates very well how the requirements of one advancing technology can spur on new developments in another technology.

British Telecom have of course a long record of achievements in the field of semiconductors, notably the long-life transistors in use in high capacity submarine cables, which won the Queen's Award for Technology 1972.

The Research Department is currently engaged in the development of prototype fabrication of large scale i.c.s.

Present designs, which make extensive use of computer based design aids, employ a 5V silicon gate NMOS technology and include a general purpose digital filter, to be first used in the SSMF4 signalling receivers of System X local exchanges. The filter contains 8,500 transistors in a silicon chip 5mm square.

The development of a 3 micrometre minimum line width silicon gate NMOS technology is now nearing completion and a 5 micrometre line width ISOCMOS process is now being established.

At the laboratories an electron microscope is used for dynamic inspection of complex prototype i.c.s. By a strobing action, the operation of the circuit is slowed down and changes of potential throughout the circuit can be seen by the observer as changes from dark to light in the projected image. Thus

. . . from the World of Electronics

INVESTING IN THE HIGHLANDS

GIM is investing £8·5 million in expanding its semiconductor plant at Glenrothes. Nippon Electronics of Japan has confirmed Livingston New Town, Scotland, as the site for its first European manufacturing plant.

The NEC's investment of £40 million will eventually employ 800 people. Meanwhile the EEC has granted over £3 million in regional aid to 14 Scottish-based companies, four of them in the electronics industry.

INMOS Start-up

The British Government-backed INMOS company is hoping to start volume production of solid-state 16K memories in the first quarter of 1981.

Manufacture, however, will be in the United States in a new factory at Cheyenne Mountain, Colorado Springs. The first INMOS UK factory will not be completed until 1982 and a possible second factory in the UK has, as yet, no start date.

Information Technology

One Minister and one government department should be responsible for co-ordinating government policies towards information technology. This is the main recommendation of a report from the Advisory Council for Applied Research and Development (ACARD) published in September. The report, *Information Technology**, which was produced by a working group chaired by Sir Robert Clayton, Technical Director of G.E.C. Limited, describes information technology as "perhaps the most important area of application of microelectronics".

The report states that hardware is available for all needs whereas software is limited by shortage of people to prepare programmes. Another major problem is the attitude of people towards computerised methods. A more favourable climate of public opinion has to be created to win wide acceptance of the new technology.

To remedy the shortage of 25,000 to 40,000 people in the software area, immediate steps must be taken to train suitable personnel in industry. As a long term measure, plans must be made to take entrants from a wide area, and not limited to mathematicians and scientists.

* Available from HMSO bookshops, price £3·30.

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any defects in any part of the chip are made visible.

Testing Time For Components

Reliability and Life-Time Tests of electronic components intended for use in telecommunications equipment is a vitally important activity at British Telecom Research Laboratories.

Three particularly interesting physical causes of failure in i.c.s that are investigated are: *electromigration,* where the movement of aluminium atoms along a conductor caused by collisions with the conducting electrons can result in voids leading eventually to open circuits; *dielectric breakdown;* and *corrosion,* due to absorbed moisture on the chip surface.

Stringent tests are performed on plastic encapsulated semiconductors to ensure a sufficiently high standard amongst these cheap mass produced components. There is increasing pressure for their use in telecoms and other professional applications on account of their greater availability and low cost.

Thick film hybrid microcircuits are extensively used in telecoms, and because of the varied technologies involved, special tests have been devised to assess potential reliability.

ANALYSIS

THE DOLLAR WATCH

Before the British currency was decimalised the coinage enjoyed a rich vocabulary of slang. The "joey", "tanner", "bob", "half-dollar", "dollar", the "half-quid", the "quid". The dollar was so-called because the exchange rate was of the order of four US dollars to the British pound sterling in pre-war days. And, back in 1938, you could buy a serviceable watch for a dollar, that is 25p by today's nomenclature.

The dollar watch was a little miracle of engineering for the price. About two inches in diameter and a quarter inch thick it was packed with its "works" of mainspring, gear train, balance wheel with its delicate hairspring, its escapement mechanism. Remove the back and you could see the wheels go round. It had a loud re-assuring tick and fitted snugly in the waistcoat pocket.

A real bargain for a dollar. That is until you recall that in 1938 the average wage for a male industrial worker was £3·45 for a 48-hour week and the ladies averaged only £1·63 for their 44-hour stint.

Today, following years of inflation, average incomes are well over 20 times those of 1938. But if we take a factor of 20 as the inflation rate then the dollar watch of 1938 should now cost a "fiver".

In such relative terms the dollar watch is back. For just under a "fiver" (£4·95 to be precise) you can now buy the 1980 equivalent. Waistcoats are out of fashion so the package is designed for wear on the wrist with stainless steel strap included in the price.

The old clockwork mechanism is gone, so have the dial and hands. Instead there is a chronometer standard quartz oscillator "movement" and liquid crystal digital readout giving the date as well as time. Daily re-winding is supplanted by a once-a-year change of battery. The comforting audible tick is replaced by an equally comforting visual on-off flash of the colon every second.

The dollar watch explains much of what has happened during the past 40 years. The little miracle of miniature mechanical engineering is displaced by the even greater miracle of microminiature electronic engineering. We have found a better way of making watches. It's a pity that the ancient craft of the watchmaker is fast disappearing but nobody can honestly deny that the new product is far superior for the same price.

An even greater pity is that today's dollar watch is made in the Far East. But that's just another sign of our changing times.

Brian G. Peck

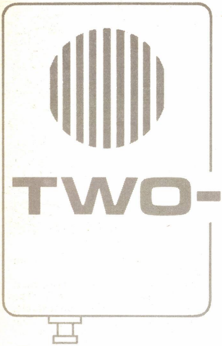
Eddystone Radio, with a long history of making quality short-wave receivers, has now moved into the transmitter business with an initial contract from the BBC to build fifty 1kW MF broadcast transmitters.

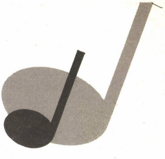
The Central Electricity Generating Board is looking at wind-power as a supplementary form of electricity generation. Early trials would most likely be on a flat inland area with a 100kW generator but a chain of interlinked 1MW windmill generators is envisaged.

Semi—Growth

Sources in the US say that the world trade recession will only check, not reverse, semiconductor sales growth. In 1980, for example, growth will only be 14 per cent.

By 1983, however, industry sales will have risen at a compound growth rate of 24 per cent. I.C.s still have the highest growth rate but discretes sales are still growing but at a much lower annual rate.





TWO-NOTE DOOR CHIME

BY W.J.KEELEY

Some time ago the author was asked to help some elderly relatives who were having some difficulty with their doorbell. The basic problem was that of audibility and the solution seemed to be a strident two-tone door chime that could if required, be easily repeated in other areas of the house.

The chime must of course be reliable and should if possible be battery operated, with a long battery life. Various ideas were considered and finally a simple circuit using two CMOS integrated circuits was evolved and it is this circuit that forms the basis of this project.

CHIME

The chime consists of two cascaded 0·5 second timers controlling two tone generators whose outputs are combined to drive a simple loudspeaker output stage. Pressing the door-push triggers the first timer which turns on the 800Hz tone generator.

After about 0·5 second the timer resets disabling the 800Hz tone. The action of turning the tone generator off is used to trigger the second timer which turns on the 400Hz tone generator, again for about 0·5 second. When the second timer resets the 400Hz tone is turned off, ending the chime sequence.

The unit is self-contained and needs only a suitable door-push to operate it. Experience shows that it is well worthwhile investing in a good quality door-push, especially if it's situation is in any way exposed—the contact plating on cheap switches is very thin and doesn't take long to corrode.

Being totally solid state this chime is triggered by a voltage change which means there is little or no contact wear on the door-push. With electromechanical chimes, on the other hand, the door-push contacts have to carry current and arcing can occur because of the inductance of the electromagnet windings when the door push is released. The resulting contact wear leads to corrosion and eventual failure.

DUAL MONOSTABLE

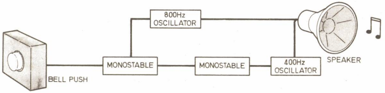
The full circuit is shown in Fig. 1. IC1 is a 4528 CMOS dual monostable connected in cascade to provide the sequential timing pulses. The timing components, R2, C1, R3, C2 have been chosen to give an interval of about 0·5 second. The other i.c., IC2, is a 4011 CMOS quad NAND gate arranged as two simple oscillator circuits to form the tone generators.

The spare input of the first gate in each oscillator is used as a control input and is connected to the *Q* output of the respective monostable. The remainder of the circuit is a simple output stage to drive the loudspeaker.

It may seem a little strange that the battery is shown permanently connected. This is quite in order as CMOS integrated circuits only draw supply current when they are actually changing logic state. Under steady state conditions the supply current is solely due to leakage effects and is of the order of a few microamps.

The best measurement the author was able to make of the chime steady state current was 5 to 10 microamps.

HOW IT WORKS



A bell push is connected via two monostables to two oscillators.

When the switch is activated, the first monostable comes on and switches on the first oscillator. After a short period this resets activating the second monostable which turns on the second oscillator.

After a further short period this also resets and the bell push must be pressed again to restart the sequence.

During operation the chime draws a peak current of about 10mA. Experience so far, indicates that battery life for a PP6 is about 12 months. Use of a smaller battery, such as a PP3 is not recommended.

CIRCUIT PRINCIPLES

Before considering circuit operation in detail it is worthwhile looking at the monostables and tone generators. The monostables used in the chime have two trigger inputs, *A* and *B;* a clear input, *CD* and two outputs, *Q* and $\overline{Q}$. The logic of the monostable is such that when triggered the *Q* output goes to logic 1 and remains in this state for a time determined by the external timing components.

The two trigger inputs are designed to respond to "edges", that is they respond to the rate of change of the trigger signal rather than the actual voltage level. Input *A* is triggered by positive edges, that is a transition from logic 0 to logic 1, whilst input *B* is triggered by negative edges, or transitions from logic 1 to logic 0.

RESET

A further input *CD,* is used to reset the monostable if it is desired to terminate the timing sequence. A logic 0 at this input will reset the *Q* output to logic 0 and the $\overline{Q}$ output to logic 1. One further aspect of the monostables used in the chime is that they are retriggerable.

This simply means that a further trigger signal applied during the timing period will extend that period. In our application this is something of a disadvantage because pressing the door-push again while the first note of the chime is sounding will extend the period of that note.

To overcome this would involve additional logic and the author feels that the problem is not sufficiently serious to warrant increasing the complexity of the circuit.

LINEAR OPERATION

An interesting property of CMOS gates is that they are capable of linear operation in the region where the output changes logic state. If a resistor is connected between input and output it is possible to bias the gate so that it performs as a high gain amplifier. This principle is used in the tone generator circuits.

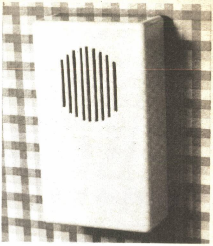
Two NAND gates are cascaded and a resistor is connected between the midpoint and an input of the first gate. A capacitor between this input and the output of the second gate completes the circuit. When the control input is taken to logic 1 both gates go into their linear region, the second gate being biased by the output of the first.

The capacitor provides heavy positive feedback and the circuit functions as a relaxation oscillator at a frequency determined by the time constant of the bias resistor and the feedback capacitor.

COMPLETE CIRCUIT

Finally we can consider the chime circuit as a whole. Initially the *Q* outputs of the monostables, IC1a and IC1b are at logic 0 and the $\overline{Q}$ outputs at logic 1. Both tone generators, IC2a/b and IC2c/d are disabled by their control inputs being held at logic 0 by the respective monostable *Q* output.

Input *A* of monostable 2, IC1b, is held at logic 1 by the $\overline{Q}$ output of IC1a. Monostable 2 is not triggered because, as explained earlier, input *A* is triggered by a positive transition rather than a steady logic 1.



Operating the door-push takes input *A* of IC1a to logic 1 (+9V). The transition triggers the monostable, output *Q* goes to logic 1 and $\overline{Q}$ to logic 0. The logic 1 at *Q* enables the 800Hz tone generator IC2a/b and the output from this drives the output transistor via R6. At the end of the timing period IC1a resets and disables the 800Hz tone generator.

Output $\overline{Q}$ goes to logic 1 and this transition triggers IC1b via input *A*. The 400Hz oscillator IC2c/d is enabled and drives the output stage via R7 to generate the second note of the chime sequence.

At this stage in the chime operation there is no reason why monostable 1 could not be triggered again by inadvertant operation of the door-push. This would cause the two chime notes to be generated simultaneously giving a rather odd effect, so to prevent mis-operation in this way the *Q*

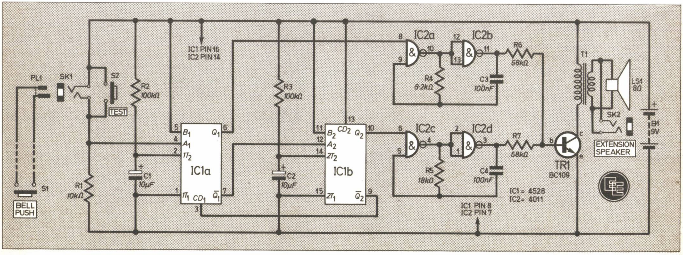


Fig.1. Complete circuit diagram of the Two-Note Door Chime.

TWO-NOTE DOOR CHIME

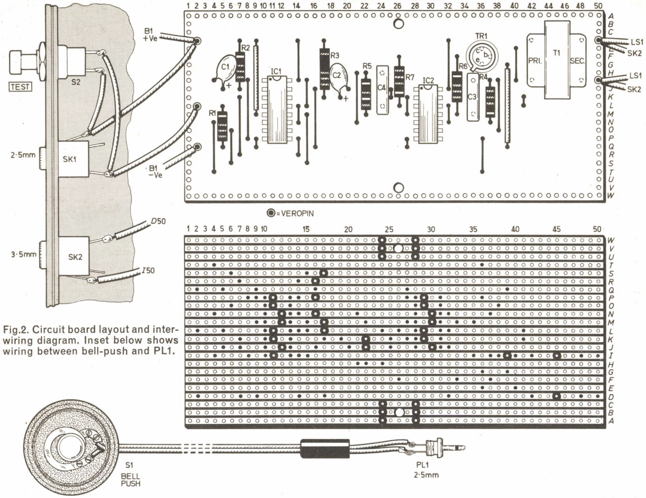


Fig.2. Circuit board layout and interwiring diagram. Inset below shows wiring between bell-push and PL1.

COMPONENTS

Resistors

R1	10kΩ
R2	100kΩ
R3	100kΩ
R4	8·2kΩ
R5	18kΩ
R6	68kΩ
R7	68kΩ

All ¼W carbon ± 5%

Capacitors

C1	10μF 16V tantalum bead
C2	10μF 16V tantalum bead
C3	100nF polyester
C4	100nF polyester

See **Shop Talk** page 792

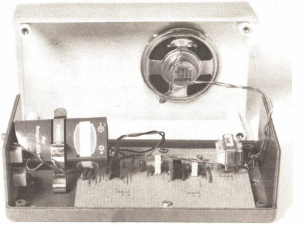
Semiconductors

IC1	CD4528 CMOS dual resettable monostable
IC2	CD4011A CMOS quad two-input NAND gate (see text)
TR1	BC109 *npn* silicon

Miscellaneous

S1	Single pole bell push
SK1	2·5mm miniature jack socket
SK2	3·5mm miniature jack socket
PL1	2·5mm miniature jack plug
B1	9V PP6 type
LS1	miniature type, eight ohms impedance
T1	miniature transistor output transformer type LT700.

Case, size 188 × 110 × 60mm, Verocase type 202-21031G, or similar; stripboard, 0·1 inch matrix, 35 strips by 45 holes; battery connector; Terry clip to hold battery; interconnecting wire; nuts, bolts and spacers to mount circuit board and battery clip.



View inside the unit from the side showing battery in position and loudspeaker wiring.

COMPONENTS approximate cost £5·50 excluding case

output of IC1b is connected to the clear, *CD*, input of IC1a.

During the second chime note this output is at logic 0 and so holds IC1a in the reset mode preventing triggering. At the end of the chime sequence the clear input is restored to logic 1 and normal operation of IC1a can begin when it is next triggered by the door-push.

STATIC PROTECTION

From a practical point of view the only specific component requirement for the door chime is that IC2 must be the suffix "A" version of the 4011 without static protection. The static protection circuits on the inputs of the "B" version prevent the linear mode of operation which is essential for proper operation of the tone generators.

It is also desirable that the timing capacitors, C1, C2 and the output and supply decoupling capacitors, C5, C6 be tantalum capacitors to ensure low leakage current when the chime is inactive. Take great care with the integrated circuits and avoid unnecessary handling, especially IC2.

CONSTRUCTION starts here

CIRCUIT BOARD

Construction is straightforward and presents no special problems. Work begins with the component board as this can be completely assembled and tested prior to fitting in the chime case.

Cut the 0·1 inch stripboard to the overall size given in Fig. 2. An easy way to cut stripboard is to score along the adjacent row of holes to cutting edge using a scriber and straight edge —do this on both sides of the board.

Grip the required part of the board firmly on a flat surface such as a table edge. Gently flex the off-cut until it breaks cleanly along the score line. The edge is finished with a file taking particular care no whiskers of copper are left to bridge tracks.

Drill the two fixing holes and using Fig. 2 as a guide, plot and break the copper track in the positions marked. Make certain the track is cut cleanly and all swarf is removed.

The first step in assembly is to fit the i.c. sockets as these provide a handy reference for locating the other components. Next come the wire links, now fit the resistors and capacitors. Make sure the electrolytics are correctly polarised.

Some makes of tantalum bead capacitors are legended and the positive lead is usually marked with a "+". Other makes are colour coded. Finally fit the output stage components and terminal pins. The board is now ready for checking and testing.

TESTING

The board should first be checked very thoroughly for mistakes and bad joints. Once you are satisfied all is well a push-button can be temporarily connected. Likewise connect the loudspeaker and finally wire up the battery connector lead making certain that the positive battery lead (red) is connected to the correct terminal. Plug the battery in.

It is likely the chime will sound a partial sequence as the circuit settles down. Press the test button. The chime should now sound a complete two note sequence. If it doesn't work disconnect the battery and check the wiring and assembly again. If nothing is apparent reconnect the battery and do some basic fault-finding.

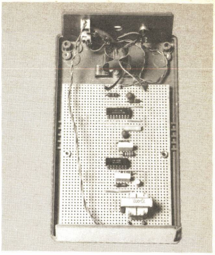
First check that the voltage on the i.c. supply pins is correct. Next test the monostables by checking that the *Q* output of IC1a goes to logic 1 when the test button is pressed and the the *Q* output of IC1b goes high approximately one second after the button is operated. The tone generators are best tested by removing IC1 and temporarily linking the appropriate control input to the positive supply rail.

CASE

When the chime board has been tested it can be mounted in the base section of the cabinet. This is a standard Verobox type 202-21031G, size 188 x 110 x 60mm, and features knock-out keyhole slots in the base for easy wall mounting. Start by sorting out the correct mounting slot to use, cut this out and clean up with a round file. Fit the battery clip at the opposite end of the case such that the battery will lie lengthwise. (See photographs.)

Drill the mounting holes for the component panel and for the door-push socket SK1. Finally comes the most tricky part of the operation, cutting the loudspeaker slots in the case lid. Slots were chosen in preference to anything else as they are more in keeping with the appearance of the chime.

Mark a 25mm diameter circle in the position shown in the photographs on the underside of the lid. Draw a horizontal diameter across the circle and mark the positions of the slots. Draw vertical guide lines for each slot and drill a 3mm hole at the top of each slot. Carefully cut down the slots with an Abrafile in a hacksaw frame and finally clean up with a small file.



Inside view of the case showing circuit board and wiring to sockets and test push switch.

Available low cost imported small loudspeakers are not generally provided with fixing holes and are intended to be secured in place by small metal brackets hooked over the rim. These are rather fiddling to make and the author would suggest a simple alternative—epoxy adhesive. Although crude, this is perfectly satisfactory provided care is taken to avoid getting adhesive on the cone.

When the loudspeaker is fixed in place the chime can be fully assembled and retested prior to final installation.

INSTALLATION

Installation is straightforward and as mentioned earlier, battery life should be of the order of one year in normal use. The output stage and battery decoupling circuits were included to minimise distortion caused by unwanted feedback effects due to the rise in internal resistance of the battery as it ages.

Change the battery when the chime note becomes distorted to avoid any damage due to chemical leakage from the exhausted battery.

Battery removal is no problem and maintenance is further aided by connecting the door-push to the chime with a miniature 2·5mm jack socket and plug.

In the prototype chime a 3·5mm jack socket was fitted to allow connection of a small extension loudspeaker in another room. If you do fit an extra loudspeaker, then the combined impedance of the extension and internal loudspeakers should not be less than 8 ohms. To achieve this you may well have to increase the impedance of the internal loudspeaker to 16 ohms.

A test button was also provided on the unit. Both these facilities are optional and can be omitted if not required.

RADIO WORLD

By Pat Hawker, G3VA

TV by Telephone

One reason why the video telephone—demonstrated in Germany well over 40 years ago—has remained a dream rather than practical reality is that you cannot send high-quality pictures along a pair of ordinary telephone wires, at least not very far. The high-frequency components of a broadband signal soon get lost and there are problems of phase and crosstalk. But I remember in the mid-sixties seeing demonstrations of a German equalising unit that allowed a black-and-white 405-line picture to be sent perhaps a mile along a good telephone circuit and come out still looking quite reasonable.

So it was interesting to see at the recent *Open Day* at British Telecom (Post Office) Research centre at Martlesham, Suffolk some of the work that is still going on in the field of limited-bandwidth real-time and slow-scan TV systems. These successfully overcome problems of distortion and crosstalk when used in the local switched telephone network.

A surprisingly effective 313-line system with a bandwidth of 1MHz (instead of the 5MHz of the conventional 625-line system) can be sent more than a mile over standard telephone circuits without intermediate repeaters: such systems would allow local video telephone calls to be made at very modest charges. A digitally-coded version of this system has a bit-rate of 2Mbit/s and could be sent for virtually any distance along the standard pulse-code-modulation circuits widely used on urban junction routes: in effect this would be equivalent to 30 speech circuits compared with the 1,000 speech circuits needed for a full-bandwidth 5MHz TV signal.

British Telecom are also looking seriously at a whole range of different "slow-scan" TV systems in which a series of high-definition still pictures can be sent in times that vary from 2 minutes to 4 seconds per frame. The 4-second rate (64kbit/s) is equivalent to a speech path on System X, the new digital telephone system on which so many hopes of the British Telecommunications industry are based.

This useful research has still to answer one question: when *you* use the telephone do you want to be seen as well as heard? Sometimes perhaps, but I suspect not very often. Another research establishment noticed that people talking together seldom spend much time watching the speaker's face.

First catch your frog

For centuries, electromagnetic radiation or radio waves in the form of lightning static remained unnoticed and, until a little more than a century ago, unsuspected. But then, in a remarkably short time between about 1885 to 1915, a whole series of ingenious techniques were developed to detect radio waves and so permit the practical realisation of radiotelegraphy. These included spark-gap detectors, coherers and magnetic detectors, thin-film and capillary detectors, thermal detectors, crystal (semiconductor) detectors and thermionic detectors.

From a recently published book by Dr Vivian Phillips of University College of Swansea, entitled *Early Radio Wave Detectors* published by Peter Peregrinus Ltd in association with the Science Museum, one can learn how scores of ingenious ideas were developed and tested successfully, only later to sink into obscurity. Contrary to commonly accepted beliefs, the Fleming thermionic diode and the De Forest audion triode made little immediate impact on the scene and the real breakthrough perhaps came with the very sensitive regenerative detector based on the triode developed by Howard Armstrong and others just before World War I. Dr Phillips, however, places the "modern era" rather earlier, about 1910.

It is just as well that some of the ideas did fade away. For example, Lefeuvre's "physiological detector" required the user to find, kill and expose the muscle nerve of a frog (before rigor mortis set in), an idea hardly calculated to appeal to the modern radio listener.

Arthur Isbell, on the other hand, took advantage of our sense of taste. In his system, two small silver electrodes were placed against the tongue and apparently it was possible to read by "taste" morse signals at speeds of 5 to 10 words per minute. Some signals apparently had a "sour stinging taste" and could produce the sensation of toothache, while the listener also experienced an optical sensation of lights dimming with each pulse due to contraction of the irises in the eyes.

If Morse could do that one wonders just what would be the disco-lights effect of hard rock broadcasts!

Pictures from Space

The reception of TV programmes in our homes directly from geostationary satellites 22,300 miles above the equator, with the prospect in "overspill" areas of being able to watch the programmes of other countries, is an interesting and quite exciting prospect for the not-so-distant future. But, personally, it is not something that I expect to be able to do as a matter of course for quite a few years yet.

Some of the more sensational forecasts clearly fail to distinguish between what is becoming technically feasible and the long pull still needed before direct-broadcast satellites (DBS) are likely to be fully established on an operational basis in Europe. One has still to assess the problems presented by the need to pinpoint and rectify the fault that caused the *Ariane* launch failure last May.

A less spectacular but quite significant set-back to DBS has been the premature failure of the two 100-watt travelling-wave-tube amplifiers on the Japanese *Yuri* (Broadcast Satellite Experiment) spacecraft. This was launched a couple of years ago and initially gave very encouraging results. So far only one high-power TWT amplifier (on board the Canadian *Hermes*) has survived its full term of life.

This is one reason why there seems a lot in favour of the latest Canadian intention of introducing a new CBC programme channel by using just one relatively low-power satellite transponder and then depending on the very large number of Canadian cable (wire-distribution) systems to deliver the pictures into the homes. At the same time it has shown in current field trials that it will be possible for viewers not on cable systems to pick up the broadcasts direct from the satellite by using aerial dishes of 1·2 to 1·8 metre diameter instead of the smaller 60cm to one-metre dish contemplated for higher power DBS systems. These large aerials would, of course, be more expensive and more difficult to protect against wind and snow, but then they would be used only in a few remote homesteads.

Such a system combines the proven effectiveness, low costs and reliability of "distribution" satellites (as used very widely in North America and elsewhere) but is attractive only in those countries where the penetration of multi-channel cable systems is very high. In practice the average Canadian viewer on cable already has access to more TV programme choice (Canadian and American) than viewers almost anywhere else in the world.

For many of us the real question is whether more programme choice really means a better TV service: the debate between "broadcasting" and "narrowcasting". It will be interesting to see the results of the current Home Office study of the implications of DBS by 1985 or 1990 in the United Kingdom, promised by about the end of this year.

Novice Licences

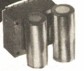
As somebody who believes that Amateur Radio in this country would benefit from the introduction of a third class of licence that would enable newcomers to enjoy some h.f. operating while still studying for the Radio Amateurs Examination and the Morse Test, it is disappointing to learn that the Home Office is showing reluctance even to consider seriously a novice licence.

In Australia, for example, novice licences were introduced a few years ago (about the same time as 27MHz CB) and today there are some 6,100 full licences, 3,300 "limited" licences for v.h.f. only (equivalent to our Class B licences that do not require a Morse test) and 3,200 holders of the novice licence which has presented far fewer problems to the authorities than the controversial CB facilities. West Germany is the latest country to introduce a form of transistional licence to encourage h.f. operation.

It seems a great pity that the British licensing authorities always seem to be lukewarm towards any extension of non-professional radio.

NEW

PRACTICAL ELECTRONICS PROJECT 125 WATT POWER AMP KIT



SPECIFICATIONS

Max. Output power	125 watt RMS
Operating voltage (DC)	50-80 Max.
Loads	4-16 ohms
Frequency response Measured at 100 watts	25Hz-20kHz
Sensitivity for 100 watts	400mV @ 47K
Typical T.H.D. @ 50 watts 4 ohms load	0.1 %
Dimensions	205 x 90 and 190 x 36 mm

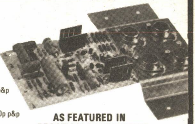
The P.E. power amp kit is a module for high power applications—disco units, guitar amplifiers, public address systems and even high power domestic systems. The unit is protected against short circuiting of the load and is safe in an open circuit condition. A large safety margin exists by use of generously rated components, the output stage uses four 115 watt transistors normally only two would be used, result, a high powered rugged unit. The PC Board is backprinted, etched and ready to drill for ease of construction, and the aluminium chassis is preformed and ready to use. supplied with all parts and circuit diagrams.

125 watt power amp kit **£9.50** plus £1.00 p&p

ACCESSORIES

Suitable L.S. coupling electrolytic **£1.00** plus 20p p&p

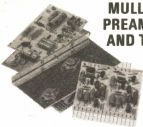
Suitable Mains Power Supply Unit sufficient for one power amp **£7.50** plus £2.75 p&p



AS FEATURED IN PRACTICAL ELECTRONICS OCTOBER ISSUE

DIY STEREO BARGAIN PACKS FEATURING FAMOUS BUILT MULLARD PREAMP MODULES

MULLARD STEREO PREAMP MODULES AND TWO 12 WATT POWER AMP KITS.



In easy to build form P.C.B.s backprinted, etched and drilled ready to use.

BUILD A 12 WATTS PER CHANNEL STEREO AMPLIFIER £6.00

ACCESSORIES AND L.S. KIT EXTRA *(not available separately)*

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ACCESSORIES: Available only at time of purchase of Bargain Packs

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NOTE: for use with 4 to 8 ohms speakers.

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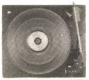
Size 9¼″ x 8¾″ x 4″ approx.

NOTE:
for use with 4 to 8 ohms speakers.

£13.95 plus £2.55 p&p

BSR chassis record deck with manual set down and return, complete with stereo ceramic cartridge **£8.50** plus £2.75 p&p when purchased with amplifier. Available separately **£10.50** plus £2.75 p&p.

8″ SPEAKER KIT. 2 Phillips 8″ approx. speakers. **£4.75** per stereo pair plus £1.50 p&p when purchased with amplifier. Available separately **£6.75** plus £1.50 p&p.



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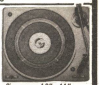
OFFER! SAVE MONEY by purchasing 12 + 12 amp kit, BSR record deck and speaker kit together for only **£25.50** p&p £4.50.



BSR Manual single play record deck with auto return and cueing lever. Fitted with stereo ceramic cartridge 2 speeds with 45 rpm spindle adaptor ideally suited for home or disco use.

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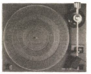
Size approx 13″ x 11″

PHILLIPS RECORD PLAYER DECK GC037

Size approx 15¼″ x 12¼″



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£27.50 complete plus £2.75 p&p

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(Constructors pack 7) plus £1.75 p&p

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*** Easy to build * 5 push button tuning**
*** Modern styling design * All new unused components**
*** 6 watt output * Ready etched & punched P.C.B.**
*** Incorporates suppression circuits * Now with tape input socket**

All the electronic components to build the radio, you supply only the wire and solder as featured in the Practical Electronics March issue. Features: Pre-set tuning with five push button options, black illuminated tuning scale, with matching rotary control knobs, one, combining on/off volume and tone-control, the other for manual tuning, each set on wood simulated fascia.

The P.E. Traveller has a 6 watts output, neg ground and incorporates an integrated circuit output stage, a Mullard IF module LP1181 ceramic filter type, pre-aligned and assembled and a Bird pre-aligned push button tuning unit. The radio fits easily in or under dashboards.

Complete with instructions.

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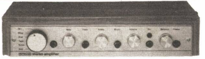
Suitable stainless steel fully retractable locking aerial and speaker (approx. 6″ x 4″) is available as a kit complete **£1.95** per pack, p&p £1.00

Pack 7A may only be purchased at the same time as Pack 7.

NOTE: Constructor's pack 7A sold complete with radio kit **£15.20** including p&p.

FEATURED PROJECT IN PRACTICAL ELECTRONICS.



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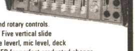

Brushed aluminium fascia and rotary controls. Size approx 14″ x 4″ x 10¼. Five vertical slide controls, master volume, tape leverl, mic level, deck level, PLUS INTER DECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level controls (PRL) lets YOU hear next disc before fading it in. VU meter monitors output level. Output 100 watts RMS 200 watts peak.

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50 WATT MONO DISCO AMPLIFIER

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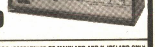

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I Can't Do Maths!

BY GEORGE HYLTON

DON'T DESPAIR. THIS FOUR-PART SERIES PROVIDES A GUIDE TO BASIC CONCEPTS

2 - DAMNED DOTS

INVENTING figures was easy. For small numbers you just made one mark for each unit; so 1, 2, and 3 became I, II, and III in the Roman system. For larger numbers this becomes cumbersome, so you invent new symbols.

If you count on your fingers, 5 is a logical number for a new symbol because it is "one handful of ones." So we have the Roman V. Similarly 10 is two handfuls and merits its own symbol such as X.

Roman numerals are cumbersome to multiply and divide with. What is XII times XV? It's easy enough to do the calculation in our numbers, but try to do the same thing in roman numerals and you'll soon get in a mess.

The trouble is that the roman number-system had no symbol for zero. This makes multiplying and dividing very difficult. Perhaps this was the true reason for the decline of the Roman Empire: they just couldn't do the complex arithmetic needed by a highly-organised economy!

The zero is said to have originated in India then spread to the Persian and Arabic worlds. Our number-system is a modified form of the Arabic system. The invention of a sign for zero makes decimal numbering easy. It also leads naturally to decimal fractions. We don't know exactly how the zero-symbol was invented, but a plausible guess is that it arose when some kind of aid was used in counting.

Suppose you are counting the people as they pass one by one through a narrow gate, the ancient equivalent say of a turnstile.

A watcher could record the number of spectators without doing any arithmetic at all, by dropping a pebble into a bag every time somebody went through the gate. This procedure registers the number of people all right but for a big crowd you need an awful lot of pebbles. And although the size and weight of the bagfull give a splendid general impression of the total number they don't, at a glance, give the precise number. For this you have to count the pebbles.

You can imagine the bag being handed over to some ancient accounts clerk. He might count the pebbles into a little box. When he reached 10 he might empty the box but register the "ten" by placing a single pebble into another box. So now there's a "tens" box as well as a "ones" box.

When the "tens" box accumulates ten pebbles it could be emptied and a single pebble put into a "hundreds" box, and so on. In this way the number of pebbles needed to record a large number of people is vastly reduced. Any number up to 9999 can be registered by using at most 36 pebbles.

Moreover, the number can be read off from the number of pebbles in each box. To record it in written form all you need to do is write down the contents of each box in order, starting, say, with the "thousands" box, then the "hundreds" and so on. Thus if there were two pebbles in the "thousands" box and five in each of the others the number must be 2555.

But if a box is empty you must have a symbol to record this fact, because if you were simply to ignore an empty box you would then record the wrong number. If for example the "hundreds" box were empty, as it would be if the number were 1028, it is no good writing 128. The zero symbol is all-important.

If it's not people you are counting but money, weights, and so on, which can be divided (a pound into pence, a gram into milligrams and so on) the system still works. All you need is to add a box for "tenths", a box for "hundredths" and a box for "thousandths", etc. But now when you write down a number you have to show where the fractional units start.

If you have three pebbles in the "ones" box and six in the "tenths" box you mustn't write down 36, but put some sort of mark after the 3 to show that this is the point where the ones end and the tenths begin. In the English-speaking world we write 3·6, but any sort of agreed dividing mark will do.

In continental Europe a comma is generally used instead of a decimal point. Here, we traditionally use commas to mark off thousands, for example, 58,653. Since this looks to many foreigners like what we understand by 58·653, scientists have agreed to substitute a gap for the thousands comma, so 58,653 becomes 58 653.

Percentages are easily turned into decimal fractions. Per cent just means "per hundred" and "per" means "divided by". So 12% = 12/100 which is 0·12. For percentages over 100% you end up with numbers over 1.

Vulgar fractions like $\frac{1}{2}$ or $\frac{3}{4}$ are turned into decimal fractions by dividing the top number by the bottom number. Normally, it won't go; for example, in $\frac{3}{4}$, 4 won't go into 3. But if you turn 3 into 30 tenths it will. You are then left with two tenths and if you turn these into 20 hundredths you can again divide by 4 and this time there is no remainder so the calculation is finished.

In long division, the calculation is:

$$\begin{array}{r} 0{\cdot}750 \\ 4\,\overline{)\,3{\cdot}000} \\ 2{\cdot}8 \\ \hline 20 \\ 20 \\ \hline 00 \end{array}$$

You needn't think about tenths and hundredths, because once the decimal point is inserted at the point where whole numbers cease and fractions begin the process is no different from ordinary long division of whole numbers. If you run out of figures in the number you are dividing (3 in this example), you just add another 0.

The justification for this follows on from what we were saying about counting into boxes. If the units box contains three pebbles and the tenths, hundredths, and thousandths boxes are empty the number represented by the pebbles can be written, 3·000 with as many extra noughts as you like since *all* the fraction boxes are empty.

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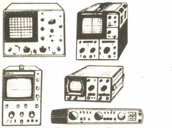

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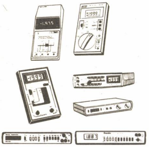

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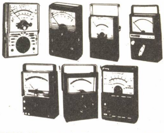

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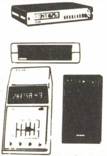

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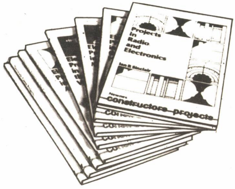
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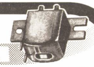

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LETTERS

Calculator for Joggers

I have just completed building the *Phone Call Charge Jogger* (E.E. October '80) and found it a very worthwhile project to build and use.

With the addition of a cheap Woolworth's "Texet" calculator it is possible to make a meter with a digital readout of cost.

I connected the "=" button to the 9 volt battery eliminator plug inside the calculator enabling it to be used as a normal calculator as well as on the call meter. This was then connected to a suitable relay in place of the lamp. Each time the device is to be used, "3·5 + 3·5 =" has to be entered. The Jogger is then switched on and used as described in the article.

Every time the unit charges up 3·5p, the calculator will indicate the accummulated amount spent plus an additional 7p, so this must be subtracted from final total to arrive at the cost of the call.

Each time the device counts the Jogger must be reset. To overcome this a pair of contacts from the relay could be placed across the reset button on the Jogger so when the relay pulls in it pulls out again almost immediately to automatically reset the Jogger.

David Plumb (Age 13),
Enfield, Middlesex

The idea of linking circuits to a calculator for display and basic computation is not original, but nevertheless the application here is a good one. Using a calculator for this purpose does not involve the user in any modifications should the basic unit cost alter. This is carried out by the entry via the calculator keyboard. Also V.A.T. can be accounted for during accumulation. For example if the unit cost is 3·5p, then the unit cost including V.A.T. at the present rate equals 4·025, which would be the figure to key in initially.

Mail Order

I always read with interest *Counter Intelligence* in EVERYDAY ELECTRONICS, and I should like to comment on Mr. Young's remarks on "Mail Order" in the October 1980 issue.

Of course we know what Mr. Young means by point (1); but as William Caxton could have told him one can't print without a printing press, and type or a block. Moreover I do not myself care for all-block-capitals. I think it looks uncouth, and it prevents one distinguishing the Post Town as requested by the Post Office. (See Postal Addresses and other publications.)

Your point (4) (about allowing for inflation) is surely impractical, or needs amplification. If obeyed as it stands, almost every order would need a cheque in return as change—unless the balance were retained as a tip, and I hardly think you intend that. The thing to do is either to pay by credit card or send a cheque made out for a maximum amount in words and ask the supplier to fill in, in figures, the actual amount required.

In this way one can cover uncertainty over the amount required for p&p, and also the possibility that some items ordered may be not available. I learned this method many years ago from the Box Office, the Royal Shakespeare Theatre, Stratford-on-Avon. It saves a lot of trouble on both sides.

Too often mail-order firms send out catalogues which in effect tell lies. One receives a catalogue, picks out a number of attractive lines, and sends off an order. When the parcel arrives a number of items are absent, and the advice note says "not available". Yet in the parcel is a new catalogue or price list offering these very items.

This has happened to me several times, and the inference I make is that the lines were not in stock when the first catalogue was sent out.

E. F. Good,
Darlington

Timer Circuits

I am a new reader of your magazine, as I want to know more about i.c.s. Also I bought the October edition as I wanted something like the *Phone Call Charge Jogger* featured in it. However I was disappointed to note that this is no more than an *RC* circuit, not very accurate.

I saw on the accompanying Wall Chart that "Timer" i.c.s are listed, and then found that two of these are used in the *Darkroom Controller*. But surprise, surprise, that circuit is also no more than an *RC* circuit! I ask what function is served by the NE555 i.c.? I thought that something better would be possible with an i.c. designed as a timer.

I am looking for a timer with a little more accuracy than the conventional *RC* delay, without going to the expense and complication of quartz crystal control. Are any other of your circuits more suitable?

I look forward to learning more about i.c.s from your new series and hope you will soon tell me how to select the most appropriate item from the Wall Chart, and how to use it.

R. Gobbett,
Basingstoke, Hants.

We are sorry to hear that you were disappointed with the Jogger circuitry. This device never claimed high accuracy nor is this demanded for its intended use. Its main function is to alert the subscriber that another unit has clocked up on his bill with the resetting action providing an annoyance or nuisance factor that will help or jog their memory to this effect. We do not consider the inclusion of a more sophisticated high accuracy timer to have any benefit. In fact the unit would then take that much longer to pay for itself in terms of any savings it may provide.

The 555 timer i.c. employed in the Darkroom Timer is a very accurate timer having little variation with temperature and more important the supply voltage. The properties of the external timing capacitor and resistor will determine the overall accuracy of the timer. Use of highly stable capacitors, and metal film or oxide resistors will provide an accurate repeatable timing period. The tolerance of these components can be accounted for by means of voltage control to pin 5 (not employed in this project). In fact, voltage control to pin 5 could be used to determine timing periods over a 10:1 range.

Extreme accuracy for such a project is in our opinion not required. After all, the accuracy of a conventional mechanical timer is far less that can be obtained with the 555 timer i.c.

All timers we know of are based on the charging of a capacitor through a resistor—even quartz crystal timers. Accuracy is dependent to some extent on the region of the capacitor charge (or discharge) curve that is being monitored. Inaccuracies will arise when the regions near the top of the charge curve are used. This is the case with the Jogger circuit, but not with the 555 where a specific region, that between one-third and two-thirds the supply voltage, is monitored.

Crystal control is not possible for producing long time intervals unless a divider is added to its output which adds considerably to the cost.

The Precision Timer in last month's issue could be the one you are looking for although this is based on an RC circuit, but has integral divider.

Your requirements for help in selecting devices from the Wall Chart has been noted and could be covered in a later article.

U.V. and Glass

Referring to *Reader's Letters* in your October 1980 edition on the answer to the letter from Mr. Craig concerning p.c.b.s.

Please do *not* use glass to hold the pattern to the photo-resist board when exposing to ultraviolet rays. Glass is quite opaque to all ultraviolet radiation and the experiment would not work. Better to use nothing to hold the pattern to the coated board or use clips at the edge, outside the pattern.

W. Smith,
St. Annes-on-the-Sea,
Lancs.

We have not to date been able to investigate the u.v. transmission properties of glass, but can report that glass has been used on several occasions by us with successful results. The glass was from a bathroom cabinet shelf. Exposure time was about 20 minutes. Could it be that this glass has special properties regarding u.v. light?

PLEASE TAKE NOTE

TTL Logic Probe *(September 1980)*

We apologise for some errors that occurred in Fig. 2. An additional break is required to be made on the underside of the board at location *F*14. Diodes D2 and D1 are shown reversed. Their anodes and cathodes should be transposed.

Audio Effects Unit *(October 1980)*

Please note that there should be an additional break at position *K*8 on the circuit board.

WORKSHOP MATTERS

By Harry T. Kitchen

Further additions

Last month we looked at the items required for the basic tool kit so that an active and productive life as an electronics enthusiast could be pursued. This month I want to continue the theme, taking in tools and "bits and pieces" that will both extend our capabilities and make life easier. So where should we spend our hard earned pennies?

Well, perhaps the best place is the last section covered last month: soldering irons and solder. If you have ever picked up a soldering iron by the business end you will have noticed how very hot it was; if it was plugged in, that is! So the very first addition should be a good safe soldering iron stand.

Most manufacturers supply them to suit their irons, but it is quite simple, and much cheaper, to fabricate your own from a piece of sheet aluminium. You need nothing elaborate, just a stand that will protect you and your clothing from the hot bit; at the same time, it must have adequate ventilation so that the iron does not over-heat. A lot depends on the design of the iron you have.

Having protected yourself and possessions from the hot iron, you must now take precautions to protect the components that you will be soldering, and this is not as fatuous as you may at first sight think.

Correct soldering depends upon depositing the correct amount of solder, at the correct temperature, on the component to be soldered. The melting point of even 60/40 solder is far higher than the tolerance levels of most components, unless applied for the absolute minimum amount of time essential for a good soldered joint.

This means that the component must be protected from excessive heat, or more accurately excessive heat applied for an excessive length of time. To do this you need a heat shunt which does precisely that; it shunts heat away from a vulnerable component.

The simplest shunt is a pair of slim nose pliers, but that normally requires the use of three hands! Proper heat shunts cost very little, and though they come in a variety of forms, all those that I have tried work well.

Connecting leads

If you indulge in any form of experimental work, you will sooner or later require, temporarily, to join "something" to "something else". You can string wires about, perhaps soldered at various points, but in my experience a proper set of connecting leads is well worth while making up.

For electronics work you need nothing more than 14/0·076 inch, or in metric, 16/0·2mm. Ideally it should be in as many colours as you can find or buy, and a suitable length varies from 12 inches to around 3 feet or their metric equivalents.

At the end of every lead you stick a connector. These can be small and large crocodile clips, 2mm and 4mm terminal plugs, the same at both ends, and mixed. You need to arrive at as many permutations as you can; sooner or later you will need them. These can be tidily strung up from hooks attached to the wall or work bench.

Keeping notes

I am sure that I am not the only person with a poor memory. Some of us are worse than others. The moral of this is to keep copious notes of everything you do, no matter how advanced you may be, or confident of your memory.

Sketch out every circuit, note every measurement, every calculation. A hard backed A4 ring binder is as good as anything for this as plain, lined, and squared paper can be intermixed. Also keep a note of the date and, if extreme, of the temperature.

Some circuits are temperature dependant, and may not operate properly at extremes; if you have a note of the temperature you may get an inkling to the probable cause. You may well think that the professional, strict way, is a waste of time, but events will almost certainly prove you wrong.

Good housekeeping

"Good housekeeping? The man is mad!" I can hear you exclaim. Not so. Long experience has convinced me that an extension of keeping notes to tidy working is very necessary to achieve high constructional output and maintain domestic harmony, as well as prolonging the life of your tools. Still not convinced? Let me expound further.

It is all a matter of courtesy and common sense. Courtesy where others are concerned means that if you are not master of your own domain you must request permission, and obtain it, before committing acts of vandalism on your electronics components.

While you work away, you must be on the guard for drops of solder which adhere most viciously to carpets, leaving evidence of their presence. Similarly, be on your guard against snippings of wire which fly off like missiles with a mind of their own, and lodge in the most unexpected places. Don't leave the soldering iron where it can burn the table, hence the stand. In short do unto others...

When you close your constructional activities, you should leave everything nice and tidy, so that you are welcome another time. But where do you put it all, all your myriad bits and pieces? Well, I have found from practical experience that jam jars are invaluable for the impecunious, and these will accommodate most of your components, the larger and heavier excepted.

Jam jars allow you to examine the contents fairly easily, whilst strong cardboard boxes will permit storage of the rest, as well as soldering irons and tools. Tools, though, ought to have their own storage, and here old drawers, cutlery trays and the like come in very useful, for they permit division of the tools to some extent. This division stops the tools knocking around and getting damaged and worn.

If your talents extend to woodwork you can make yourself a made to measure tool box with a compartment for everything, and really this is the ultimate aim; a proper home for every tool. It has another benefit too, and that is the absence of any tool is soon noted so that it can be rescued.

If you have the necessary cash, then undoubtedly a proper storage system is highly desirable, necessary even, if you have much to store. I have, over several years, acquired a set of inter-locking drawers in three sizes. All come with dividers, and form the most useful storage system for small to medium sized electronics components that I have in my own workshop.

They are certainly, in the long term, far preferable to the individual chest of drawers that one can buy. I have two of these, bought before I discovered the inter-linking drawers, and not only are they dissimilar, but I have seen neither for sale since.

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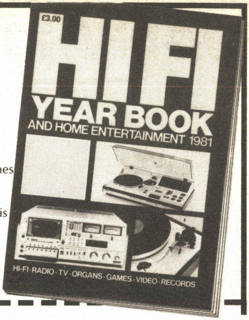
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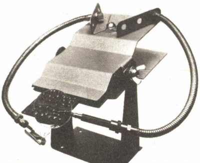

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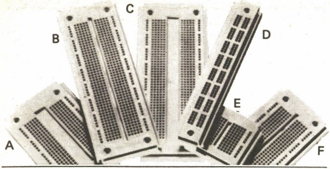

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2N3055	55
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2N3704	9
2N3705	10
2N3773	297
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2N3904	9
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Electrolytic Axial –10% to +50% Tol. **Order Code** Cap 015 + μF

μF V	16	25	40	63
1.0				9
1.5				9
2.2				9
3.3				9
4.7				9
6.8			9	10
10		8		10
15	8		9	11
22		8		13
33	8		9	
47		8	11	13
68	9			
100		9	13	
150	9	10		31
220	13		26	36
330			30	40
470		23	32	47
680	21	30	39	54
1000	25	30	59	
1500	35	39		
2200	42			

Polyester Radial Leads **Order Code**
Dipped Type, C280/352 Style Cap 352
Moulded Type, 10.2mm Pitch Cap 360
+ Value

μF	352	360	μF	352	360
.001		7	.1	7	9
.0015		7	.15	8	10
.0022	6	7	.22	9	11
.0033	6	7	.33	11	
.0047	6	7	.47	14	
.0068	6	7	.68	17	
.01	6	8	1.0	21	
.015	6	8	1.5	30	
.022	6	8	2.2	35	
.033	6	8			
.047	6	8			
.068	7	8			

Electrolytic Radial Leads –10% to +50% Tol. **Order Code** Cap 034 + μF

μF V	10	16	25	35	40	50	63
.47							7
.68							7
1.0							7
1.5							7
2.2							7
3.3							7
4.7					7		8
6.8			7			8	9
10		7			8		9
15		7	8			9	11
22	7	8			9	11	
33		8	9		11		
47	8	9		11			
68		9	11				
100	9						
150	11						

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Metal Film, Fixed		
0.5W, E24 Values, SRI-IM, 2% Tol.	8 each	Res MR30
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Metal Glaze, Fixed		
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Skeleton Presets, Miniature		Order Code
0.1W, E3 Values, 100R-IM, Lin. Vertical Mounting	8	Min. Preset V
0.1W, E3 Values, 100R-IM, Lin. Horizontal Mount	8	Min. Preset H + Value
Skeleton Presets, Standard		
0.3W, E3 Values, 100R-4M7, Lin. Vertical Mounting	11	Std. Preset V
0.3W, E3 Values, 100R-4M7, Lin. Horizontal Mount	11	Std. Preset H + Value
Potentiometer, Rotary		
0.5W, E3 Values, 1K-2M2 Lin.	39	Ro Pot Lin
0.25W, E3 Values, 4K7-2M2 Log.	39	Ro Pot Log + Value
Potentiometer, Slider		
0.5W, E3 Values, 2K2-470 , Lin.	45	Sl Pot Lin
0.25W, E3 Values, 1K0 - 1M0 Log.	45	Sl Pot Log + Value

MAINS TRANSFORMERS

Order Code

Secondaries may be connected in series or parallel to give wide voltage range
Primaries 0-220, 240V

6VA – Clamp Type Construction 235 each

Approx. 18% Regulation F.C. 54, H36, W35

0-4.5V, 0-4.5V Secondaries Trans 6VA
0-5V, 0-6V
0-12V, 0-12V
0-15V, 0-15V
0-20V, 0-20V

20VA – Clamp Type Construction 360 each

Approx. 16% Regulation F.C. 70, H48, W46

0-4.5V, 0-4.5V Secondaries Trans 20VA
0-6V, 0-6V
0-12V, 0-12V
0-15V, 0-15V
0-17.5V, 0-17.5V
0-20V, 0-20V

Plastic Boxes – Boss Industrial Mouldings

Moulded Box and Close Fitting Flanged Lid
ABS Box, C/W Brass Bushes, and Lid In Orange

		Order Code
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L150 W80 D50	131	Case BIM2005 OR
L190 W110 D60	223	Case BIM2006 OR

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ABS Base, C/W Brass Bushes, In Orange
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L111 W71 D42	150	Case BIM4004 OR
L161 W96 D53	208	Case BIM4005 OR

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DPDT	C/Off	111	SW 8A2021
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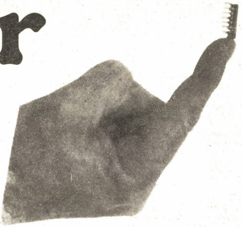

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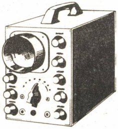

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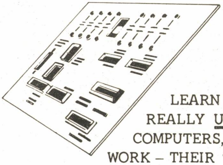

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CD4042	£0·83
CD4043	£1·01
CD4044	£0·94
CD4045	£1·61
CD4046	£1·50
CD4047	£1·00
CD4049	£0·55
CD4050	£0·55
CD4054	£1·27
CD4055	£1·15
CD4056	£1·55
CD4069	£0·20
CD4070	£0·20
CD4071	£0·20
CD4072	£0·20
CD4081	£0·20
CD4082	£0·25
CD4510	£1·27
CD4511	£1·44
CD4516	£1·15
CD4518	£1·15

LINEAR IC'S

CA3011	£1·12
CA3014	£1·55
CA3018	£0·75
CA3020	£1·96
CA3028	£0·92
CA3035	£1·61
CA3036	£1·15
CA3042	£0·73
CA3043	£2·13
CA3046	£0·81
CA3052	£1·84
CA3054	£1·27
CA3075	£1·73
CA3081	£1·73
CA3089	£2·30
CA3090	£4·14
CA3123	£2·19
CA3130	£1·07
CA3140	£0·81
CA3065E	£0·95
LM401	£0·33
LM304	£1·84
LM308	£1·15
LM309	£1·73
LM380	£0·98
LH381	£1·67
LM3900	£0·67
MC1303L	£0·98
MC1304	£2·19
MC1310	£1·09
MC1312	£2·19
MC1350	£1·38
MC1352	£1·61
MC1469	£3·39
MC1496	£1·04
NE536	£3·06
NE550	£1·09
NE555	£0·23
NE556	£0·69
NE565	£1·38
NE566	£1·73
NE567	£1·96
UA702C	£0·53
72702	£0·53
UA703	£0·29
UA709	£0·29
72709	£0·53
709P	£0·29
UA710C	£0·46
72710	£0·35
UA711C	£0·37
72711	£0·37
UA723C	£0·52
72723	£0·52
UA741C	£0·28
72741	£0·28
741P	£0·23
UA702C	£0·69
72747	£0·69
UA748	£0·40
748P	£0·40
SN76013N	£1·97
SN76023N	£1·97
SL414A	£2·24
TAA5508	£0·40
TAA621A	£2·30
TAA6218	£2·88
TAA661	£1·73
TAD100	£1·50
TBA540	£2·42
TBA810S	£0·85
TBA810	£1·13
TBA820	£0·81
TBA9200	£2·88
TCA270S	£2·30
TBA800	£0·92
SN76110	£1·73
SN76115	£2·19
SN76660	£0·86
TBA120	£0·60
TBA6413	£2·53
TBA641A	£1·84
2N414	£1·15

DIODES

AA119	£0·09
AA120	£0·09
AA129	£0·09
AAY30	£0·10
AAZ13	£0·17
BA100	£0·12
BA102	£0·37
BA148	£0·17
BA154	£0·14
BA155	£0·16
BA173	£0·17
BB104	£0·46
BAX13	£0·08
BAX16	£0·09
BY100	£0·25
BY101	£0·25
BY105	£0·25
BY114	£0·25
BY124	£0·25
BY126	£0·17
BY127	£0·18
BY128	£0·18
BY130	£0·20
BY133	£0·24
BY164	£0·59
BY176	£0·86
BY206	£0·35
BYZ10	£0·52
BYZ11	£0·52
BYZ12	£0·45
BYZ13	£0·46
BYZ16	£0·47
BYZ17	£0·41
BYZ18	£0·41
BYZ19	£0·69
OA5	£0·69
OA10	£0·40
OA47	£0·09
OA70	£0·09
OA79	£0·12
OAB1	£0·12
OA85	£0·12
OA90	£0·12
OA91	£0·12
OA95	£0·12
OA182	£0·15
OA200	£0·09
OA202	£0·09
SD10	£0·07
SD19	£0·07
IN34	£0·08
IN34A	£0·08
IN914	£0·07
IN916	£0·07
IN4148	£0·07
IS44	£0·08
IS920	£0·07

IC PAKS

Manufacturers 'Fall Outs' which include functional and part functional units. These are classed as 'out-of-spec' from the makers very rigid specifications, but are ideal for learning about I.C's and experimental work.

16224—100 Gates assorted 7400 01 04 10 50 60 etc **£1·38**
16226—30 MXI assorted types 7441 47 90 154 etc **£1·38**
16227—30 Assorted Linear types 709 741 747 748 710 588 etc **£1·73**
16228—8 Assorted types SL403 760 13 76003 etc **£1·15**
16229—5 I.C's 76110 Equivalent to MC13130P MA767 **£1·73**

MAMMOUTH IC PAK

16223—Approx 200 pieces assorted fall out integrated circuits including Logic 74 series Linear Audio and DTL. Many coded devices but some unmarked you to identify **£1·44**

JUMBO PAK SEMI CONDUCTOR

16222—Transistors Germ and Silicon Rectifiers Diodes Triacs—Thryistors I.C's and Zeners. ALL NEW & CODED. Approx 100 pieces. Offering the amateur a fantastic bargain pack and an enormous saving **£2·59**

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16132 100 Silicon diodes 200mA OA200 **£0·69**
16133 150 Silicon fast switch diode 25mA IN41 18 **£0·69**
16134 50 Silicon rectifiers top hat 250mA **£0·69**
16135 20 Silicon rectifiers stud type 3 amp **£0·69**
16136 50 400 mW zeners D07 case **£0·69**
16137 30 NPN transistors BC107 8 plastic **£0·69**
16138 25 NPN TO39 2N697 2N1711 silicon **£0·69**
16138 30 PNP transistors BC177 178 plastic **£0·69**
16140 25 PNP TO39 2N2905 silicon **£0·69**
16141 30 NPN TO18 2N706 silicon switching **£0·69**
16142 25 NPN BFY50 51 **£0·69**
16143 30 NPN plastic 2N3906 silicon **£0·69**
16144 30 PNP plastic 2N3905 silicon **£0·69**
16145 30 Germ OC71 PNP **£0·69**
16146 15 Plastic power 2N3055 NPN TO220 case **£1·38**
16147 10 TO3 metal 2N3055 NPN **£1·38**
16149 10 1 amp SCR TO39 **£1·38**
16150 8 × 3 amp SCR TO66 case **£1·38**

TANTALUM CAPACITORS

3137	0·1MFD	35V	£0·13
3138	0·22MFD	35V	£0·13
3139	0·47MFD	35V	£0·13
3141	2·2MFD	35V	£0·14
3142	4·7MFD	35V	£0·21
3157	3·3MFD	25V	£0·21
3143	10MFD	35V	£0·25
3144	22MFD	16V	£0·25
3156	33MFD	35V	£0·13

SOCKETS

1611	8 Pin DIL	£0·10
1612	14 Pin DIL	£0·13
1613	16 Pin DIL	£0·14
1720	18 Pin DIL	£0·20
1721	20 Pin DIL	£0·22
1722	22 Pin DIL	£0·23
1614	24 Pin DIL	£0·28
1615	28 Pin DIL	£0·30
1723	40 Pin DIL	£0·36

G.P. SILICON DIODES

300mW 40PIV (min) sum-min. FULLY TESTED. Ideal for Organ builders. 30 for 68p, 100 for £2·85, 500 for £5·75, 1000 for £10·35.

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TO18 sim to 2N7068 BSY27 28 95A ALL usable devices. No open and shorts. ALSO available in PNP similar to 2N2906 BCY70. 20 for 68p. 50 for £1·15, 100 for £2·07, 500 for £9·20, 1000 for £16·10. When ordering please state NPN or PNP.

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No soldering breadboards. Simply plug components in and out of letter number identified. Nickel-silver contact holes. Start small and simply snap-lock boards together to build a breadboard of any siée.

All EXP Breadboards have two bus-bars as an ingegral part of the board. If you need more than two buses, simply snap on 4 more bus-bars with the aid of an EXP 48.

EXP 325	The ideal breadboard for 1 chip circuits. Accepts 8, 14, 16 and up to 22-pin IC's.	**ONLY £1·84**	48mm (1·9″)
EXP 350	270 contact points with two 20-point bus-bars.	**ONLY £3·62**	91mm (3·6″)
EXP 300	550 contacts with two 40-point bus-bars.	**ONLY £6·61**	152mm (6·0″)
EXP 650	For Micro-processors	**ONLY £4·14**	91mm (3·6″)
EXP 48		**ONLY £2·65**	152mm (6·0″)
EXP 600	A s EXP 300 but accepts 24 pin DIL and over.	**ONLY £7·25**	152mm (6·0″)

All EXP 300 Breadboards mifi and match with 600 series.

ANTEX IRONS

1943	15 watt quality soldering iron with 3/32″ bit	**£5·12**
1947	Replacement element for 1943	**£2·63**
1944	Iron coated bit 3/32″ for 1943	**£0·58**
1945	Iron coated bit 1/8″ for 1943	**£0·58**
1946	Iron coated bit 3/16″ for 1943	**£0·58**
1948	18 watt iron with coated bit	**£5·12**
1952	Replacement element for 1948	**£2·22**
1949	Iron coated bit 3/32″ for 1948	**£0·58**
1950	Iron coated bit 1/8″ for 1948	**£0·58**
1951	Iron coated bit 3/16″ for 1948	**£0·58**
1931	X25 25 watt iron, ceramic shaft and another shaft of stainless steel to ensure strength	**£6·12**
1935	Replacement element for 1931	**£2·05**
1932	Iron coated bit 1/8″ for 1931	**£0·58**
1933	Iron coated bit 3/16″ for 1931	**£0·58**
1934	Iron coated bit 3/32″ for 1931	**£0·58**
1953	SK1 soldering Kit—contains 15 watt soldering iron with 3/16″ bit plus two spare bits, a reel of solder, heat-sink and a booklet 'How to Solder	**£7·28**
1939	ST3 iron stand made from high grade bakelite chrom plated steel spring, suit all models—includes accommodation for six bits and two sponges to keep the iron bits clean	**£1·89**
1724	Model MLX as X25 iron but 12 volts	**£5·59**

CASES AND BOXES

Vero plastic case box. These boxes consit of top and bottom sections which include fixings points for horizontal mounting PC boards/chassis plates, the two sections are held together by four screws which enter through the base and are concealed by plastic feet.

No.	Length	Width	Height	Price
170	140mm	40mm	205mm	£4·35
171	140mm	75mm	205mm	£4·85
172	140mm	110mm	205mm	£6·30

INSTRUMENT CASES in two sections vinyl covered top and sides, aluminium bottom, front and back.

No.	Length	Width	Height	Price
155	8in	5½in	2in	£2·01
156	11in	6in	3in	£3·10
157	6in	4¾in	1¾in	£1·93
158	9in	5¼in	2½in	£2·59

ALUMINIUM BOXES made from bright alli, folded construction each box complete with half inch deep lid and screws.

No.	Length	Width	Height	Price
159	5¼in	2½in	1½in	£0·98
160	4in	4in	1½in	£0·98
161	4in	2½in	1½in	£0·98
162	5¼in	4in	1½in	£1·10
163	4in	2½in	2in	£0·98
164	3in	2in	1in	£0·67
165	7in	5in	2½in	£1·54
166	8in	6in	3in	£1·98
167	6in	4in	2ir.	£1·32

SLOPE front alumium boxes with black vinyl base and sides & aluminium back, top &front—strong construction easily accessable.

169	2⅛in	5⅜in	2¾in	12in	3½in	8in	£5·45
169	2⅝in	7½in	4in	16in	4½in	11in	£8·21

AUDIO MODULES

AMPLIFIERS

AL10	3 watt Audio Amplifier Module 22-32v supply	**£3·63**
AL20	5 watt Audio Amplifier Module 22-32v supply	**£4·11**
AL30A	7-10 watt Audio Amplifier Module 22-32v supply	**£4·78**
AL60	15-25 watt Audio Amplifier Module 30-50v supply	**£5·92**
AL80	35 watt Audio-Amplifier Module 40-60v supply	**£9·28**
AL120	50 watt Audio Amplifier Module 50-70v supply	**£15·11**
AL250	125 watt Audio Amplifier Module 50-80v supply	**£22·54**

STEREO PRE-AMPLIFIERS

PA12	Supply voltage 22-32v input senstivity 300mv suit: AL10/AL20/AL30	**£9·83**
PA100	Supply voltage 24-36v inputs:—Tape, Tuner, Mag P.U., Suit: AL60/AL80	**£20·30**
PA200	Supply voltage 35-70v inputs:— Tape, Tuner, Mag P.U., Suit: AL80/AL120/AL250	**£20·98**

MONO PRE-AMPLIFIERS

MM100	Supply voltage 40-65v inputs: Mag. P.U., Tape Microphone Max. output 500mv	**£14·29**
MM100G	Supply voltage 40-65v inputs: 2 Guitars, Microphones Max. output 500mv	**£14·29**

POWER SUPPLIES

PS12	24v Supply suit 2 × AL10, 2 × AL20, 2 × AL30 & PA12/S.450	**£1·90**
SPM80	33v Stabilised suppy—suit 2 × AL60, PA100 to 15 watts	**£5·57**
SPM120/45	45v Stabilised supply—suit 2 × AL60, PA100 to 25 watts	**£7·34**
SPM120/55	55v Stabilised supply—suit 2 × AL80, PA200	**£7·34**
SPM120/65	65v Stabilised supply—suit 2 × AL120, PA200, 1 × AL250, PA200	**£7·34**
SG30	15-0-15 Stabilised power supply for 2 × GE100MKII	**£4·37**

MISCELLANEOUS

MPA30	Stereo Magneitc Cartridge Pre-Amplifier-input 3·5mv Output 100mv	**£3·76**
S.450	Stereo FM Tuner Supply Voltage 20-30v-Varicap tuned	**£29·39**
STEREO30	Complete 7 watt per Channel Stereo Amplifier Board—includes amps pre-amp, power supply, front panel, knobs etc—requires 2050 Transformer	**£24·25**
BP124	5 watt 12v max.—Siren Alarm Module	**£4·43**
GE100MkII	10 channel mono-graphic equaliser complete with sliders and knobs	**£26·45**
VPS30	Variable regulated stabilised power supply 2-30v 0-2 amps	**£8·74**

TRANSFORMERS

			P&P
2034	1·7 amp 35v suit SPM80	**£6·21**	£1·21
2035	2 amp 55v	**£7·30**	£1·47
2036	750mA 17v suit PS12	**£3·68**	
2040	1·5 amp 0-45v-55v suit SPM 120/45. SPM 120/55v	**£5·98**	£1·21
2041	2 amp 0-55v-65v suit SPM 120/55. SPM120/65v	**£7·82**	£1·47
2050	1 amp 0-20v suit Stereo 30	**£3·74**	£0·75
1725	150mA 15-0-15v suit SG30	**£2·04**	

ACCESSORIES

139	Teak Cabinet suit Stereo 30, 320 × 235 × 81mm	**£8·05**
140	Teak Cabinet suit STA15, 425 × 290 × 95mm	**£9·78**
FP100	Front Panel for PA100 & PA200	**£2·07**
BP100	Back Panel for PA100 & PA200	**£1·84**
GE100FP	Front Panel for on GE 100MKII	**£2·05**
2240	Kit of parts including Teak Cabinet, chassis sockets, knobs to build 15 watt stereo amplifier (Does not include modules)	**£22·94**

SPECIAL OFFERS

MINIDRILL 12v hand held battery-operated mini drill. 7,500 r.p.m. Collet chuck. Ideal for drilling printed circuits or model making. No. 1402. Complete with two drills ·1, ·15. **£6·33**

TRANSFORMER 240v Primary 0-20v @ 2A Secondary. By removing 5 turhs for each volt from the secondary winding, any voltage up to 20v @ 2A is obtainable. Ideal for the experimenter. No.2042. **£1·50 + 86p. P & P**

ANTEX MLX Soldering Iron. Sturdy 25 watt iron complete with: 4½ metres of 2-core cable. Works off a 12 volt battery. Ideal for Car, Boat, Caravan. No. 1724. **£5·29**

METAL FOIL CAPACITOR PAKS

16204—Containing 50 metal foil capacitor like Mullard C280 series—Mixed values ranging from ·01uf—2·2uf. Complete with identification sheet. **£1·38**

TRIACS

2 amp TO5 case

volts	No.	Price
100	TR12A/100	£0·36
200	TR12A/200	£0·59
400	TR12A/400	£0·82

6 amp

volts	No.	Price
100	TR16A/100	£0·59
200	TR16A/200	£0·70
400	TR16A/400	£0·88

10 amp

volts	No.	Price
100	TR110A/100	£0·88
200	TR110A/200	£1·06
400	TR110A/400	£1·29

10 amp

volts	No.	Price
400	TR110A/400P	£1·29

DIACS

BR100 £0·23 D32 £0·23

SILICON RECTIFIERS

200mA

IS920 50V	£0·07
IS921 100V	£0·08
IS922 150V	£0·09
IS923 200V	£0·10
IS924 300V	£0·12

1 Amp

IN4001 50V	£0·05½
IN4002 100V	£0·06
IN4003 200V	£0·07
IN4004 400V	£0·08
IN4005 600V	£0·09
IN4006 800V	£0·10
IN4007 1000V	£0·12

1·5 Amp

IS015 50V	£0·10
IS020 100V	£0·12
IS021 200V	£0·13
IS023 400V	£0·15
IS025 600V	£0·16
IS027 800V	£0·18
IS029 1000V	£0·23
IS031 1200V	£0·29

3 Amp

IN5400 50V	£0·16
IN5401 100V	£0·17
IN5402 200V	£0·18
IN5404 400V	£0·20
IN5406 600V	£0·24
IN5407 800V	£0·29
IN5408 1000V	£0·35

10 Amp

IS10/50 50V	£0·22
IS10/100 100V	£0·24
IS10/200 200V	£0·26
IS10/400 400V	£0·40
IS10/600 600V	£0·48
IS10/800 800V	£0·59
IS10/1000 1000V	£0·69
IS10/1200 1200V	£0·79

30 Amp

IS30/50 50V	£0·64
IS30/100 100V	£0·79
IS30/200 200V	£1·07
IS30/400 400V	£1·44
IS30/600 600V	£2·02
IS30/800 800V	£2·33
IS30/1000 1000V	£2·66
IS30/1200 1200V	£3·31

60 Amp

IS70/50 50V	£0·86
IS70/100 100V	£0·97
IS70/200 200V	£1·38
IS70/400 400V	£2·01
IS70/600 600V	£2·59
IS70/800 800V	£2·88
IS70/1000 1000V	£3·45

THYRISTORS

600ma TO 18 Case

Volts	No.	Price
10	THY600/10	£0·17
20	THY600/20	£0·18
30	THY600/30	£0·23
50	THY600/50	£0·25
100	THY600/100	£0·29
200	THY600/200	£0·44
400	THY600/400	£0·51

1 amp TO 66 Case

Volts	No.	Price
50	THY1A/50	£0·30
100	THY1A/100	£0·32
200	THY1A/200	£0·37
400	THY1A/400	£0·44
600	THY1A/600	£0·52
800	THY1A/800	£0·67

3 amp TO 66 Case

Volts	No.	Price
50	THY3A/50	£0·32
100	THY3A/100	£0·35
200	THY3A/200	£0·38
400	THY3A/400	£0·48
600	THY3A/600	£0·58
800	THY3A/800	£0·75

5 amp TO 66 Case

Volts	No.	Price
50	THY5A/50	£0·41
100	THY5A/100	£0·52
200	THY5A/200	£0·58
400	THY5A/400	£0·66
600	THY5A/600	£0·79
800	THY5A/800	£0·93

5 amp TO 220 Case

Volts	No.	Price
400	THY5A/400P	£0·66
600	THY5A/600P	£0·79
800	THY5A/800P	£0·93

7 amp TO 48 Case

Volts	No.	Price
50	THY7A/50	£0·55
100	THY7A/100	£0·59
200	THY7A/200	£0·66
400	THY7A/400	£0·71
600	THY7A/600	£0·90
800	THY7A/800	£1·06

10 amp TO 48 Case

Volts	No.	Price
50	THY10A/50	£0·59
100	THY10A/100	£0·66
200	THY10A/200	£0·71
400	THY10A/400	£0·81
600	THY10A/600	£1·14
800	THY10A/800	£1·40

16 amp TO 48 Case

Volts	No.	Price
50	THY16A/50	£0·62
100	THY16A/100	£0·67
200	THY16A/200	£0·71
400	THY16A/400	£0·89
600	THY16A/600	£1·04
800	THY16A/800	£1·60

30 amp TO 94 Case

Volts	No.	Price
50	THY30A/50	£1·38
100	THY30A/100	£1·64
200	THY30A/200	£1·87
400	THY30A/400	£2·06
600	THY30A/600	£4·03

No.	Price
BT101/500R	£0·92
BT102/500R	£0·92
BT106	£1·44
BT107	£1·07
BT108	£1·13
2N3228	£0·81
2N3525	£0·89
BTX30/50L	£0·38
BTX30/400L	£0·53
C106/4	£0·69
BT116	£1·73

ZENER DIODES

400 mw (Bzy88) D007. Glass encapsulated range of voltages available. 1·3v, 2·2v, 2·7v, 3·3v, 3·9v, 4·3v, 4·7v, 5·1v, 5·6v, 6·2v, 6·8v, 7·5v, 8·2v, 9·1v, 10v, 11v, 12v. 13v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v, 33v, 39v. **No. Z4 10p**

1w-1·5w Plastic and metal encapuslated. Range of voltages available. 1·3v, 2·2v, 2·7v, 3·3v, 3·9v, 4·3v, 4·7v, 5·1v, 5·6v, 6·2v, 6·8v, 7·5v, 8·2v, 9·1v, 10v, 11v, 12v, 13v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v, 33v, 43v, 47v, 51v, 68v, 72v, 75v, 82v, 91v, 100v. **No. Z13 18p**

10w Metal stud type SO10 case. Range of voltages available. 1·3v, 2·2v, 2·7v, 3·3v, 3·9v, 4·3v, 4·7v, 5·1v, 5·6v, 6·2v, 6·8v, 7·5v, 8·2v, 9·1v, 10v, 11v, 12v, 13v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v 33v, 43v, 47v, 51v, 68v, 72v, 75v, 82v, 91v, 100v. **No. Z10 44p**

BRIDGE RECTIFIERS

SILICON 1 amp

Type	No.	Price
50v RMS	BR1/50	£0·23
100v RMS	BR1/100	£0·25
200v RMS	BR1/200	£0·29
400v RMS	BR1/400	£0·41

SILICON 10 amp

Type	No.	Price
50v RMS	BR10/50	£1·73
200v RMS	BR10/200	£1·96

SILICON 2 amp

Type	No.	Price
50v RMS	BR2/50	£0·52
100v RMS	BR2/100	£0·55
200v RMS	BR2/200	£0·60
400v RMS	BR2/400	£0·67
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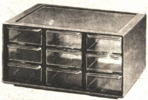

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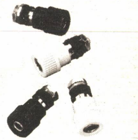

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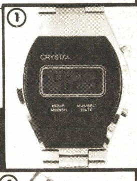

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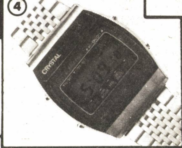

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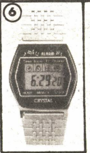

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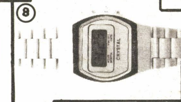

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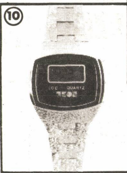

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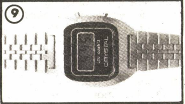

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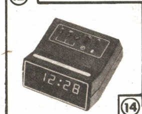

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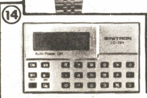

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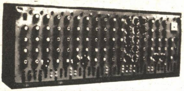

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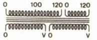

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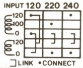

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TTP 447	0·75×2	2·14	60
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TTP 461	0·50×2	2·14	60
TTP 463	0·60×2	2·36	70
TTP 464	1·38×2	2·99	85
TTP 465	2·77×2	4·57	120
TTP 466	5·55×2	5·68	120

0v-12v 0v-12v

REF	AMPS	PRICE	P/P
TTP 467	0·25×2	1·79	50
TTP 468	0·38×2	2·14	60
TTP 470	0·50×2	2·36	70
TTP 471	1·04×2	2·99	85
TTP 472	2·08×2	4·57	120
TTP 473	4·16×2	5·68	120

0-15v 0-15v

REF	AMPS	PRICE	P/P
TTP 474	0·20×2	1·79	50
TTP 475	0·30×2	2·14	60
TTP 477	0·4×2	2·36	70
TTP 478	0·83×2	2·99	85
TTP 479	1·66×2	4·57	120
TTP 480	3·33×2	5·68	120

0-24v 0-24v

REF	AMPS	PRICE	P/P
TTP 495	0·13×2	1·79	50
TTP 496	0·19×2	2·14	60
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TTP 499	0·52×2	2·99	85
TTP 500	1·04×2	4·57	120
TTP 501	2·08×2	5·68	120

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REF	AMPS	PRICE	P/P
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TTC 450	2·08×2	3·10	85
TTC 451	4·18×2	4·70	120
TTF 452	8·33×2	5·85	120

0v-9v 0v-9v

REF	AMPS	PRICE	P/P
TTC 460	0·30×2	1·85	50
TTC 461	0·50×2	2·20	60
TTC 463	0·60×2	2·45	70
TTC 464	1·38×2	3·10	85
TTC 465	2·77×2	4·70	120
TTF 466	5·55×2	5·85	120

0v-12v 0v-12v

REF	AMPS	PRICE	P/P
TTC 467	0·25×2	1·85	50
TTC 468	0·38×2	2·20	60
TTC 470	0·50×2	2·45	70
TTC 471	1·04×2	3·10	85
TTC 472	2·08×2	4·70	120
TTF 473	4·16×2	5·85	120

0v-15v 0v-15v

REF	AMPS	PRICE	P/P
TTC 474	0·20×2	1·85	50
TTC 475	0·30×2	2·20	60
TTC 477	0·40×2	2·45	70
TTC 478	0·83×2	3·10	85
TTC 479	1·66×2	4·70	120
TTF 480	3·33×2	5·85	120

0v-24v 0v-24v

REF	AMPS	PRICE	P/P
TTC 495	0·13×2	1·85	50
TTC 496	0·19×2	2·20	60
TTC 498	0·25×2	2·45	70
TTC 499	0·52×2	3·10	85
TTC 500	1·04×2	4·70	120
TTF 501	2·08×2	5·85	120

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IN 4001	10	45	10
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BATTERY ELIMINATOR KITS 100ma radio types with press-studs 4½v **£1·64,** 6v **£1·64,** 9v **£1·64,** 4½+4½v **£2·30,** 6+6v **£2·30,** 9+9v **£2·30.** Stabilized 8-way types 3/4½/6/7½/9/12/15/18v 100ma **£3·12,** 1 Amp **£7·80.** Stabilized power kits 2-18v 100ma **£3·12,** 1-30v 1A **£8·10,** 1-30v 2A **£14·52.** 12v car convertor 6/7½/9v 1A **£1·62.**

SWANLEY ELECTRONICS
Dept. EE, 32 Goldsel Rd., Swanley, Kent.
Post 35p extra. Prices include VAT unless stated. Official and overseas orders welcome. Lists 27p post free. Mail order only.

CORED SOLDER WIRE

	10′ coils	20′ cards	¼ Kilo reels	½ Kilo reels
18 SWG 60/40	52p	90p	£3.71	£6.29
22 SWG 60/40	35p	55p	£3.98	£6.80

ALL OUR PRICES ARE INCLUSIVE
TRADE ENQUIRIES INVITED

Cash with order to:

CIRCUIT SOLDERS
INDUSTRIAL ESTATE
THRUXTON AIRFIELD
ANDOVER, HANTS.

POPULAR KITS AND PARTS

SUB-MIN MICROPHONE
Size only ½″ × ¾″ × 3/16″ so small enough for a bugging device, ex-hearing-aids but guaranteed. Price **£1·50.**

TRANSMITTER SURVEILLANCE
Tiny, easily hidden but which will enable conversation to be picked up with FM radio. Can be made in a matchbox—all electronic parts and circuit. **£2·30.**

RADIO MIKE
Ideal for discos and garden parties, allows complete freedom of movement. Play through FM radio or tuner amp. **£6·90.**

SAFE BLOCK
Mains quick connector will save you valuable time. Features include quick spring connectors, heavy plastic case and auto on and off switch. Complete kit **£1.95.**

LIGHT CHASER
Gives a brilliant display—a psychedelic light show for discos, parties and pop groups. These have three modes of flashing, two chase-patterns and a strobe effect. Total output power 750 watts per channel. Complete kit. **Price £16.** Ready made up **£4 extra.**

FISH BITE INDICATOR enables anglers to set up several lines then sit down and read a book. As soon as one has a bite the loudspeakers emits a shrill note. Kit. **Price £4·90.**

6 WAVEBAND SHORTWAVE RADIO KIT
Bandspread covering 13·5 to 32 metres. Based on circuit which appeared in a recent issue of Radio Constructor. Complete kit. Includes case materials, six transistors, and diodes, condensers, resistors, inductors, switches, etc. Nothing else to buy, if you have an amplifier to connect it to on a pair of high resistance headphones. Price **£11·95.**

SHORT WAVE CRYSTAL RADIO
All the parts to make up the beginner's model. Price **£2·30.** Crystal earpiece **65p.** High resistance headphones (give best results) **£3·75.** Kit includes chassis and front but not case.

RADIO STETHOSCOPE
Easy to fault find—start at the aerial and work towards the speaker — when signal stops you have found the fault. **Complete kit £4·95.**

INTERRUPTED BEAM KIT
This kit enables you to make a switch that will trigger when a steady beam of infra-red or ordinary light is broken. Main components—relay. photo transistor, resistors and caps etc. Circuit diagram but no case, Price **£2·30.**

OUR CAR STARTER AND CHARGER KIT has no doubt saved many motorists from embarrassment in an emergency you can start car off mains or bring your battery up to full charge in a couple of hours. The kit comprises: 250w mains transformer, two 10 amp bridge rectifiers, start/charge switch and full instructions. You can assemble this in the evening, box it up or leave it on the shelf in the garage, whichever suits you best. **Price £11·50** + £2·50 post.

G.P.O. HIGH GAIN AMP/SIGNAL TRACER. In case measuring only 5¼in × 3¼in × 1¼in is an extremely high gain (70DB) solid state amplifier designed for use as a signal tracer on GPO cables etc. With a radio it functions very well as a singla tracer. By connecting a simple coil to the input socket a useful mains cable tracer can be made. Runs on standard 4½v battery and has input, output sockets and on-off volume control, mounted flush on the top. Many other uses include general purpose amp. cueing amp, etc. **An absolute bargain at only £1·85.** Suitable 80 ohmn earpiece 69p.

10 POCKET RADIOS FOR £9.00
These are brand new but have slight faults. Most, if not all, should be repairable.

2½ ROUND PANEL METERS
All flush mounting through 2½″ round hole, with flange makes item 3″ wide approx. Made to stringent Ministry specifications. We have the following types in stock, all are moving coil unless otherwise stated. MICRO AMPMETER 500 UA—scaled 0·5. Price **£2·88p. MILLIAMP METER 500 MA**—scaled 0·500 mA. Price **£2·30p AMPERE METER** Hot wire, scaled 0-9 amp. Price **£2·30p. DUAL RANGE VOLT METER** Scale calibrated 0-10v and 0-250v. Price **£3·45p. 0-1 MA METER IMA** f.s.d. centre zero, scaled 100-0-100. Price **£3·45p.**

VU METER
Edgewise mounting, through hole size 1⅜″ × ⅛″ approx. These are 100 micro amp f.s.d. and fitted with internal 6 volt bulb for scale illumination, also have zero reset. The scale is not calibrated but has very modern appearance. Price **£2·88p.**

BALANCE METER
Edgewise mounting 100 UA centre zero. Price **£2·30p.**

1⅞″ SQUARE PANEL METER
Eagle full vision plastic front, 50 UA. Price **£4·60p** 1 mA Price **£4·03p.**

WATERPROOF HEATING WIRE
60 ohms per yard. This is a heating element wound on a fibre glass coil and then covered with p.v.c. Dozens of uses—around water pipes, under grow boxes in gloves and socks. **23p** metre.

DIAL INDICATOR
As used in tool making and other precision measuring operations, the famous John Bull accurately shows differences of 0·1mm. A beautifully made precision instrument, price in most tool shops would be £12-£15. We have a fair quantity. Price **£9·20p.**

COMPONENT BOARD Ref. W0998.
This is a modern fibre glass board which contains a multitude of very useful parts, most important of which are: 35 assorted diodes and rectifiers including four 3 amp 400v types (made up in a bridge) 8 transistors type BC 107 and 2 type BFY 51 electrolytic condensers, SCR ref. 2N 5062 25 Ouf 100v DC and 100uf 25v DC and over 100 other parts including variable, fixed and wire wound resistors, electrolytic and other condensers. A real snip at £1·15p.

FRUIT MACHINE HEART. 4 wheels with all fruits, motorised and with solenoids for stopping the wheels with a little ingenuity you can defy your friends getting the "jackpot." **£9·95** + **£4** carriage.

DESOLDERING PUMP
Ideal for removing components from computer boards as well as for service work generally. Pirce **£6·35.**

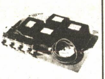
4-CORE FLEX CABLE
White pvc for telephone extensions, disco lights, etc. 10 metres **£2,** 100 metres **£15.** Other multicore cable in stock.

MUGGER DETERRENT
A high-note bleeper, push latching switch, plastic case and battery connector. Will scare away any villain and bring help. **£2·50** complete kit.

HUMIDITY SWITCH
merican made by Honeywell. The action of this device ends upon the dampness causing a membrane to stretch trigger a sensitive microswitch. Very sensitive breathing for instance will switch it on. Micro 3 amp at 250V a.c. 1·15.

MULLARD UNILEX

A mains-operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost anyone. In easy-to-assemble modular form this should sell at about **£30**—but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only **£16** including V.A.T. and postage.
FREE GIFT—Buy this month and you will receive a pair of **Goodman's** elliptical 8″ × 5″ speakers to match this amplifier.



EXTRACTOR FANS

Ex-Computer made by Woods of Colchester, ideal also as blower; central heating systems, fume extraction etc. Easy fixing through panel, very powerful 2,500 r.p.m. but quiet running. Choice of 2 sizes, 5″ **£5·50, 6″ £6·50;** post **£1** per fan.

VENNER TIME SWITCH

Mains operated with 20-amp switch, one on and one off per 24 hours repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only **£2·95.** These are new but without case, but we can supply plastic cases (base and cover) **£1·75** or metal case with window **£2·95.** Also available is adaptor kit to convert this into a normal 24-hour time switch but with the added advantage of up to 12 on/offs per 24 hours. This makes an ideal controller for the immersion heater. Price of adaptor kit is **£2·30.**

DRILL CONTROLLER

Electronically changes speed from approximately 10 revs to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions **£3·45.** Made-up model **£2** extra.

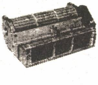
3-CHANNEL SOUND TO LIGHT KIT

Complete kit of parts for a three-channel sound to light unit controlling over 2,000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for Disco work.
The unit is housed in an attractive two-tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼″ sockets and three panel mounting fuse holders provide thyristor protection. A four-pin plug and socket facilitate ease of connecting lamps. Special snip price is **£13·50** in kit form or **£16·50** assembled and tested.

PUNCH TAPE CONSOLES

Complete units, mounted on very well built desks. The tape punch and the tape reader are set in the top, below in the cupboard is stored the power units and electronics. The keyboard is separate but plugs in and rests on the top of the desk. This is a 8 bit paper tape system. The keyboard is a standard computer type using reed switches ASC11 coded. The keyboard has 72 encoded keys. Offered complete with the data, at only a fraction of original cost, **£115** each + carriage at cost. Used but believed in good order—any section not so would be replaced. Please telephone before calling to collect.

TANGENTIAL HEATER UNIT



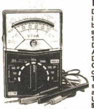
3 KW Mode
£6-95
+ £1.50 P & P

A most efficient and quiet running blower-heater by Solatron—standard replacement in many famous name heaters—comprises mains induction motor—long turbo fan—split heating element and thermostatic safety trip—simply connect to the mains for immediate heat—mount in a simple wooden or metal case or mount direct into base of say kitchen unit. Price **£5·95, post £1·50.** Control switch to give 2kw, 1kw, cold blow or off available 60p extra. 3kw model **£6·95.** Control Switch **95p.**

8 POWERFUL BATTERY MOTORS

For models, Meccanos, drills, remote control planes, boats, etc. **£2.**

MINI-MULTI TESTER



Deluxe pocket size precision moving coil instrument, jewelled bearings—2000 o.p.v. mirrored scale.
11 instant range measure:
DC volts 10, 50, 250, 1000.
AC volts 10, 50, 250, 1000.
DC amps 0-100 mA.
Continuity and resistance 0-1 meg ohms in two ranges. Complete with Test Prods and instruction book showing how to measure capacity and inductance as well.
Unbelievable value only **£6·75 + 50p** post and insurance.

FREE Amps ranges kit to enable you to read DC current from 0-10 amps, directly on the 0-10 scale. It's free if you purchase quickly but if you already own a mini-tester and would like one, send **£2·50.**

TERMS: Cash with order—but orders under **£10** must add **50p** to offset packing, etc.

BULK ENQUIRIES INVITED. PHONE: 0444-54563.

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IT'S FREE

Our monthly Advance Advertising Bargains List gives details of bargains arriving or just arrived—often bargains which sell out before our advertisement can appear—it's an interesting list and it's free—just send S.A.E. Below are a few of the Bargains still available from previous lines.

SUPER BREAKDOWN PARCEL with free gift of a desoldering pump, perhaps the most useful break-down parcel we have ever offered. Consists of 50 nearly all different computer panels on which you will find: over 300 ICs, over 300 diodes, over 200 transistors and many hundred other parts, resistors, condensors, multi turn pots, rectifiers, SCR etc. etc. for only **£8·50,** which when you deduct the value of the desoldering pump, works out to just a little over 4p per panel, + **£1·27** VAT + £2 post (it's a big parcel).

THIS MONTH'S SNIP a 3 wave band radio with stereo amplifier. Made for incorporation in a high-class radiogram, this has a quality of output which can only be described as superb. It is truly hi-fi. The chassis size is approximately 14″. Push buttons select long, medium, short and gram. Two dial lights for a scale, the pointer being moved by cord drive. The other controls are balance, volume, treble and bass. The chassis is ready built with its own mains power supply. The output is 6 + 6 watts. Brand new and in perfect working order, offered at less than value of stereo amp alone, namely **£6·90.** Post **£2·00.**

SUPER HI-FI SPEAKER CABINETS. Made for an expensive Hi-fi outfit—will suit any decor. Resonence free cutouts for 8″ woofer and 4″ tweeter. The front material is carved Dacron, which is thick and does not need to be stuck in and the completed unit is most pleasing. Colour black. Supplied in pairs, price **£6·90** per pair (this is probably less than the original cost of one cabinet) carriage £3 the pair.

OCTOBER/NOVEMBER CONSTRUCTOR'S SNIP. Here's a super bargain for you. 100 twist drills, regular tool shop price over £50, yours for only **£11·50.** With these you will be able to drill metal, wood, plastic etc from the tiniest holes in P.C.B. right up to about ¼″. Don't miss this snip—send your order today.

UNILEX OWNERS Excellent PM speakers, European made, extremely good quality and 15 ohms, the correct impedence for the Unilex. Half regular price only **£2·30** per pair + **£1** post.

MAINS ADAPTORS Why use expensive batteries—operate your radios and equipment from the mains. Save yourself pounds, with our bargain range of power packs. Sinclair gives 9v @ 100 mA—**£2·99**—Altai gives 6v 7·5 or 9v @ 300 mA **£4·10**—Crown gives 6v @ 300 mA—**£2·90**—Nixie gives 12v @ 750mA—**£3·99.** All made up in plastic cases complete with mains lead. We can also supply Mains Transistor Power Pack Kit for Voltage output anything from 3v to 16v up to 300 mA—complete kit with double insulated mains transformer and full instructions **£1·95.**

ENAMELLED COPPER WIRE We stock this on 1 lb reels and ¼ lb reels.

Gauge	1 lb	¼ lb
10—29	**£2·50 + 37p**	**£0·90 + 13p**
30—34	**£3·00 + 45p**	**£1·00 + 15p**
35—39	**£3·50 + 52p**	**£1·10 + 16p**

Thinner gauges are available—we will be pleased to quote you.

THERMOSTAT ASSORTMENT 10 different thermostats. 7 bi-metal types and 3 liquid types. There are the current stats which will open the switch to protect devices against overload, short circuits, etc, or when fitted say in front of the element of a blower heater, the heat would trip the stat if the blower fuses; appliance stats, one for high temperatures, others adjustable over a range of temperatures which could include 0-100°C. There is also a thermostatic pod which can be immersed, an oven stat, a calibrated boiler stat, finally an ice stat which, fitted to our waterproof heater element, up in the loft could protect your pipes from freezing. Separately, these thermostats would cost round about **£15·00**—however, you can have the parcel for **£2·50.**

SUPPRESSOR CONDENSER Made by famous Philips Company, this is a 3 section condenser. Main section—·2 mfd. Other 2 sections each 5000 P.F. Ideal for suppressing electrical drills and similar devices. **57p.** DITTO ·1 mfd 250v AC metal cased with fixing lug **57p.**

HIGH VOLTAGE CONDENSERS ·1 mfd 2·5 kv—**£1·15;** ·05 mfd 5 kv—**£1·15;** ·001 mfd 28 kv—**£2·30.**

HIGH VOLTAGE CERAMIC DISC CAPACITORS 47 pf, 68 pf, 100 pf, 150 pf, 220 pf—all **£10·00** per 100, **£1·50** for 10.

AC CONDENSERS In addition, to the normal uses as motor starters, power factor correction, etc, these make very good voltage droppers for working low voltage appliances from mains. The voltage working quoted is AC RMS, so these condensers are usually suitable for working on DC at 2½ times the quoted AC voltage.

1·5 mfd	440V	**64p**	6·25 mfd	250V	**£1·00**	12 mfd	440V	**£2·78**
2·5 mfd	440V	**87p**	8 mfd	250V	**£1·27**	13 mfd	275V	**£1·65**
3·4 mfd	440V	**£1·00**	8 mfd	440V	**£1·89**	15 mfd	230V	**£1·65**
3·5 mfd	250V	**77p**	11 mfd	275V	**£1·52**	15 mfd	325V	**£1·77**
5 mfd	570V	**£1·52**	12 mfd	250V	**£1·52**	20 mfd	275V	**£1·77**
						32 mfd	250V	**£2·89**

THIS MONTH'S NEW KITS

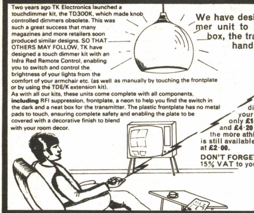
1. **STUDENT'S FIRST MULTI-TESTER** Kit contains panel meter, 12 way rotary wafer switch, resistors, rectifier, battery connector and case with pointer knob and terminals. The multi-tester, when completed, will measure DC volts 4 ranges, DC current 3 ranges, AC volts 3 ranges, resistance 2 ranges. The main value of the kit is educational, but properly completed it will prove a most useful instrument. Price **£4·99.**

2. **MULTI OPTION SOUND PRODUCER** Also called a sensational sonic siren, with it you can reproduce, for instance, American Police Siren, World War II Air Raid Alerts, and a universe of other effects. Some possible applications include burglar alarms, sound effect units, noise box to amuse the kids or to play it through your stereo to frighten away the birds and annoy your neighbours! 4 independently adjustable parameters give finger tip control. Complete kit, less case **£6·90.** Case **£2·50.**

DO YOU LISTEN IN BED? and do you use the tiny earphone so you won't disturb anyone? These tiny earphones give a very poor quality response—so why not use headphones instead? A special offer this month—Japanese made, padded 8 ohm stereo headphones for only **£2·99,** and in a nice presentation case, so would made an ideal Christmas present.

AUTOMATIC SWITCH OFF Listening in bed is a good way of putting yourself to sleep, the only snag once asleep the radio should be off. We have time switches, clockwork operated, giving on periods from 10 minutes to 3 hours, suitable for switching any electrical device up to 15 amps, radio, stereo, cooker, sunbeds, in fact anything which you don't want left switched on for too long. We have five models with on times: 0-10 minutes; 0-30 minutes; 0-1 hour; 0-1 hour 20 minutes and 0-3 hours, all priced at **£2·87** each. Control spindle—part rotation would be part of the time. Control knobs and graduated scales are available—price **£1·15** pair.

AND NOW A DIMMER THAT MAKES TOUCH DIMMERS OBSOLETE



Two years ago TK Electronics launched a touchdimmer kit, the TD300K, which made knob controlled dimmers obsolete. This was such a great success that many magazines and more retailers soon produced similar designs. SO THAT OTHERS MAY FOLLOW, TK have designed a touch dimmer kit with an Infra Red Remote Control, enabling you to switch and control the brightness of your lights from the comfort of your armchair etc. (as well as manually by touching the frontplate or by using the TDE/K extension kit).

As with all our kits, these units come complete with all components, **including** RFI suppression, frontplate, a neon to help you find the switch in the dark and a neat box for the transmitter. The plastic frontplate has no metal pads to touch, ensuring complete safety and enabling the plate to be covered with a decorative finish to blend with your room decor.

We have designed the light dimmer unit to fit a standard wall box, the transmitter to fit your hand and the price to fit your pocket.

In two years' time everyone will be selling remote control dimmers but you can have your TDRK300K kit NOW for only **£14·30** for the dimmer unit and **£4·20** for the transmitter. For the more athletic of you, the TD300K is still available at **£6·50** and the TDE/K at **£2·00**.

DON'T FORGET to add 40p P&P and 15% VAT to your total purchase.

REMOTE CONTROL COMPONENTS

LD271 IR Emitting Diode	36p
SFH205 Photodiode Detector	95p
SL480 IC Pulse Amp.	£1·70
SL490 32 command encoder/transmitter	£2·40
ML922 10 channel receiver + 3 analogue outputs	£4·20
ML926 16 channel receiver 4 momentary binary o/p	£1·40
ML928 16 channel receiver 4 latched binary o/p	£1·40
ML929 16 channel receiver 4 latched binary o/p	£1·40
Data Sheets per device	10p

These ICs can be used with infra red, ultrasonic or radio links, depending on range, cost and speed of operation.

RC500K KIT

If you do not require a sophisticated multi-channel remote control, we have developed a simple single-channel on/off infra red transmitter and receiver kit. The transmitter unit comes complete with hand held box and requires a PP3 (9V) battery. The receiver includes a triac capable of switching up to 500W at 240V a.c. and comprises a pre-amplifier bistable latch and a mains power supply, making the unit completely self-contained. The small size of the receiver enables the unit to be "built into" all kinds of equipment from lamps to tape recorders. Range: approximately 20ft. **£12·50**

LEDs

0·1" Red	9p
0·1" Green	12p
0·1" Yellow	12p
0·2" Red	9p
0·2" Green	12p
0·2" Yellow	12p
0·2" clips	3p
Rectangular Red	18p
Rectangular Green	20p
Rectangular Yellow	21p

XMAS STOCKING FILLERS

closing date 31.12.80

6 × **555 ICs**	£1·00
15 × **8-pin sockets**	£1·00
12 × **14-pin sockets**	£1·00
10 × **16-pin sockets**	£1·00
15 × **BC182**	£1·00
15 × **BC212**	£1·00
2 × **TIC226D triacs**	£1·00
12 × **Red LEDs 0·2"/0·1"**	£1·00
10 × **Green LEDs 0·2"/0·1"**	£1·00
10 × **Yellow LEDs 0·2"/0·1"**	£1·00
2 × **LM380 2W audio amp.**	£1·50
1 × **LM2917 + socket**	£1·50

INTEGRATED CIRCUITS

555 Timer	21p
741 Op. Amp.	19p
AY-5-1224 Clock	£2·60
AY-5-1230/2 Clock/Timer	£4·50
AY-3-1270 Thermometer	£8·20
ICL7106 DVM (LCD drive)	£7·00
LM377 Dual 2W Amp	£1·45
LM3795 Dual 6W Amp	£3·50
LM380 2W Audio Amp	80p
LM382 Dual low noise Preamp	£1·00
LM386 250mW low voltage Amp	75p
LM1830 Fluid Level Detector	£1·50
LM2907 f-v Converter (8 pin)	£1·40
LM2917 f-v Converter (14 pin)	£1·60
LM3909 LED Flasher/Oscillator	60p
LM3911 Thermometer	£1·20
LM3914 Dot/Bar Driver	£2·10
MM74C911 4 digit display controller	£6·50
MM74C915 7 segment-BCD converter	96p
MM74C926 4 digit counter with 7 seg o/p	£4·50
S566B Touchdimmer	£2·50
S9263 Touchswitch 16-way	£4·85
SN76477 Complex Sound Generator	£2·52
TBA800 5W Audio Amp.	68p
TBA810AS 7W Audio Amp.	£1·00
TDA1024 Zero Voltage Switch	£1·20
TDA2020 20W Audio Amp.	£2·85
ZN1034E Timer	£1·80

All ICs supplied with data sheets.
Data Sheets only **10p** each device.

SPECIAL OFFER
D.V.M. THERMOMETER KIT

Based on the ICL 7106. This kit contains a PCB, resistors, presets, capacitors, diodes, IC and 0·5" liquid crystal display. Components are also included to enable the basic DVM kit to be modified to a Digital Thermometer using a single diode as the sensor. Requires a 3mA 9V supply (PP3 battery). Closing date 31.12.80 **£17·50**

MINI KITS

These kits form useful subsystems which may be incorporated into larger designs or used alone. Kits include PCB, short instructions and all components.

MK1 TEMPERATURE CONTROLLER / THERMOSTAT
Uses LM3911 IC to sense temperature (80°C max) and triac to switch heater. 1KW **£4·00**

MK2 SOLID STATE RELAY
Ideal for switching motors, lights, heaters, etc. from logic. Opto-isolated with zero voltage switching. Supplied without triac. Select the required triac from our range. **£2·60**

MK3 BAR/DOT DISPLAY
Displays an analogue voltage on a linear 10-element LED display as a bar or single dot. Ideal for thermometers, level indicators, etc. May be stacked to obtain 20 to 100 element displays. Requires 5-20V supply. **£4·75**

MK4 PROPORTIONAL TEMPERATURE CONTROLLER
Based on the TDA 1024 Zero voltage switch, this kit may be wired to form a "burst fire" power controller or a "proportional temperature" controller enabling the temperature of an enclosure to be maintained to within 0·5°C. 3KW **£5·55**

MK5 MAINS TIMER
Based on the ZN1034E Timer IC this kit will switch a mains load on (or off) for a preset time from 20 minutes to 35 hours. Longer or shorter periods may be realised by minor component changes. Maximum load 1KW. **£4·50**

BOXES

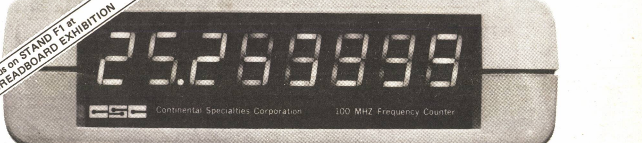
Moulded in high impact ABS. Supplied with lids and screws. Black or white.
B2 95 × 71 × 35mm **85p**
B3 115 × 95 × 37mm **95p**

ALL COMPONENTS ARE BRAND NEW AND TO SPECIFICATION. ADD VAT AT CURRENT RATE TO ABOVE PRICES. 40p P&P MAIL ORDER — CALLERS WELCOME BY APPOINTMENT.

TK Electronics
(EE), 11 BOSTON ROAD,
LONDON W7 3SJ. TEL. 01-579 9794

BARCLAYCARD VISA

See us on STAND F1 at
LONDON BREADBOARD EXHIBITION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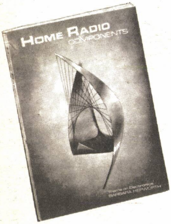

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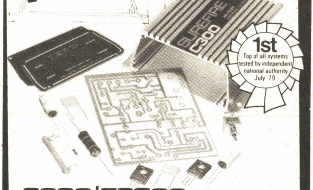
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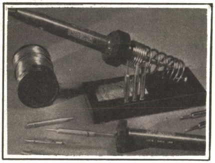

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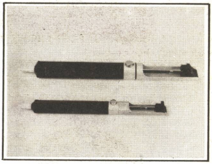

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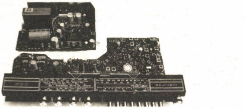

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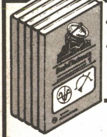

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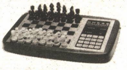

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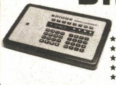

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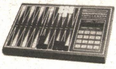

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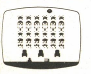

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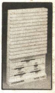

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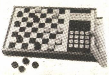

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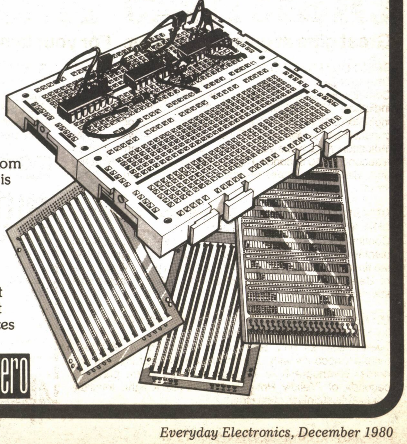

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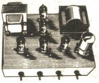

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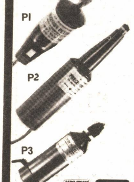

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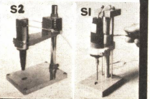

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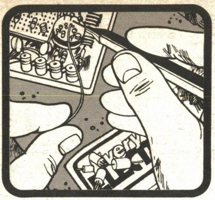

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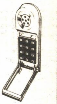

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4082	25p
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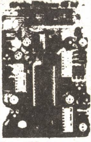

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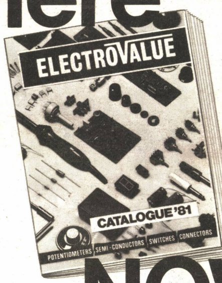

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